



# Final Cut Studio

Workflows

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This preface covers the following:

- About Final Cut Studio Workflows (p. 5)
- About the Final Cut Studio Documentation (p. 6)
- Additional Resources (p. 6)

The *Final Cut Studio Workflows* document has been designed to summarize the overall post-production process and show how the various applications in Final Cut Studio fit into it. This manual also explains how the applications in Final Cut Studio work together, letting you send projects and media from one environment to another to perform specialized tasks.

## About Final Cut Studio Workflows

Although every video and film program has different needs, the truth is that the post-production workflows of most programs, from music videos to feature-length documentaries, follow a very similar path. Every program needs to have its source media ingested, organized, edited, and color corrected; its audio mixed; and the entire program mastered and finally output; more or less in that order.

Where the workflows of various projects differ is in finding the best way to match the acquisition format of the source media to the type of output that's required for exhibition, at the highest level of quality appropriate for the budget.

For example, if you're working on a documentary or narrative feature, your workflow will vary depending on the combination of acquisition and delivery formats you use. Possible combinations include:

- Shoot using a high definition camera for a broadcast release
- Shoot using a digital cinema camera for film output
- Shoot on film for a direct-to-DVD release
- Shoot on film for finishing via a digital intermediate workflow
- Shoot on film for finishing via a negative conform

There are many more possible combinations of input and output formats, and Final Cut Studio can accommodate nearly all of them. The important thing to remember is that the type of program you're working on has less of an effect on your workflow plan than do decisions concerning how best to match the original acquisition format of your media to the required output format of your program's final master. Once that's settled, everything in between can be determined based on your hardware setup, how much time you have to complete the project, and how you like to work.

As much as is possible, *Final Cut Studio Workflows* attempts to provide a universal guide to creating a workflow using the Final Cut Studio applications, based on the factors that will have the greatest effect on increasing your efficiency in post-production.

## About the Final Cut Studio Documentation

*Final Cut Studio Workflows* provides an overview of relevant features in the Final Cut Studio applications that support the workflows being described, but for more information, consult the documentation for each application. To access the onscreen help for an application, open the application and choose the application's help from the Help menu.

The documentation for the Final Cut Studio applications is also available (in English) at:

- <http://documentation.apple.com>

## Additional Resources

The following websites provide general information, updates, and support information about Final Cut Studio, as well as the latest news, resources, and training materials.

### Final Cut Studio Website

For more information about the applications included in Final Cut Studio, go to:

- <http://www.apple.com/finalcutstudio/overview.html>

### Apple Service and Support Websites

The Apple Service and Support website provides software updates and answers to the most frequently asked questions for all Apple products, including all Final Cut Studio applications. You'll also have access to product specifications, reference documentation, and Apple product technical articles:

- <http://www.apple.com/support>

For support information about all Final Cut Studio applications, go to:

- <http://www.apple.com/support/finalcutstudio>

Discussion forums are also available to share information about each of the applications in Final Cut Studio. To participate, go to:

- <http://discussions.apple.com>

For more information about the Apple Pro Training Program, go to:

- <http://www.apple.com/software/pro/training>





# Developing a Post-Production Strategy

# 1

This chapter covers the following:

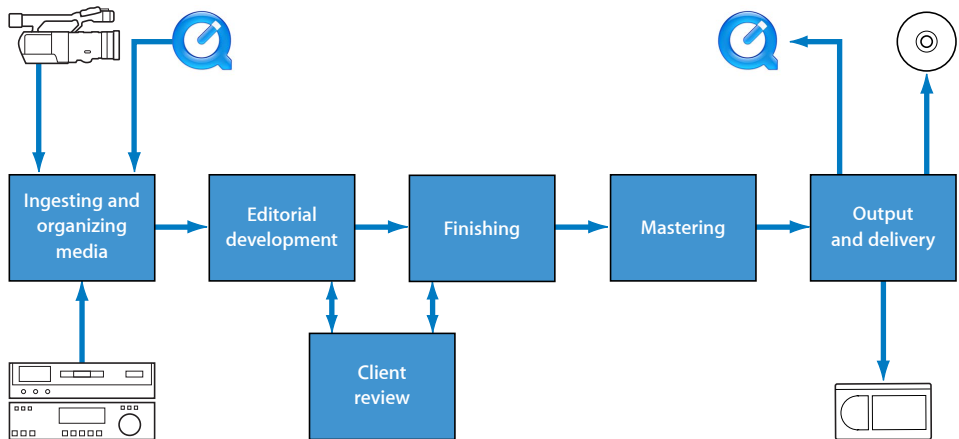
- The Overall Post-Production Workflow Explained (p. 9)
- Why Design Your Workflow in Advance? (p. 13)
- Types of Overall Workflows (p. 14)

This chapter discusses, in broad strokes, the overall workflows and strategies you can employ for ingesting, editing, finishing, and mastering various kinds of programs. In the process, you can see how choosing one ingest strategy over another affects not just how you work in Final Cut Pro, but also how you'll eventually finish, color correct, and master your program.

## The Overall Post-Production Workflow Explained

Every project has its own unique requirements. Factors such as the acquisition format chosen for the shoot, the amount of media that must be managed during editing, the overall quality of the media, and the delivery requirements for the final product all have a hand in shaping the details of your workflow.

Before focusing on where workflows diverge in different projects, it's helpful to take a step back and look at how all workflows are alike. In this overview, you can see how every single project you work on in Final Cut Studio—from music videos to educational and corporate communication programs to feature films—follows the same basic process.



### Stage 1: Ingesting and Organizing Your Media

The first stage in any post-production pipeline is to ingest the film-originated, tape-based, or tapeless media files that you shot or generated into Final Cut Pro. Different types of media require different ingest methods; for example, ingesting from tape requires the Log and Capture window, and ingesting from a tapeless format requires the Log and Transfer window. Ingesting film-originated media, on the other hand, requires additional steps to develop the camera negative and transfer it to a video or image format that can be ingested into Final Cut Pro, sometimes with the help of Cinema Tools and Color.

During ingest, you'll already be taking steps to organize your media by choosing what media to ingest and by adding logging information, such as clip names and notes. After ingest is complete, you immediately take other organizational steps to sort clips into bins and review, mark, and annotate each clip using controls in the Browser.

Although most of this work takes place in Final Cut Pro, other applications may come into play during this part of the process. Transferred film may come into Final Cut Pro through a Cinema Tools database, which provides additional logging and tracking data from the film-transfer process. Multiple-suite post-production facilities may benefit from using Final Cut Server to manage project and media files on a storage area network (SAN) to facilitate projects worked on by a post-production team.

There's one key decision that you make during ingest that affects editorial development, and later, finishing. This is whether to ingest your program's media at an offline resolution, where visual quality is lower but the media is easier to work with, or at an online resolution, where the visual quality is superior but the media requires more processing power to work with and more storage space.

For more information about using Final Cut Pro, Cinema Tools, and Color for different ingest strategies, see "Ingesting and Organizing Your Media."

### **Stage 2: Editorial Development**

Editorial development is when your project is put together. Sometimes referred to as the *offline* edit or the *story* edit, this is where the raw media that you ingested in stage 1 is turned into an edited program.

Some programs are assembled entirely within Final Cut Pro, where you can create all the titles and effects you need and do any necessary sound design right in your sequence while you edit. However, don't forget that there are other applications in Final Cut Studio that you can turn to for specialized tasks. For example, you can create master templates in Motion for use as generators from within Final Cut Pro, or you can use Motion to create broadcast graphics and composites that you can then edit into the Final Cut Pro Timeline. As you work, you can also send specific audio clips from the Final Cut Pro Timeline directly to Soundtrack Pro to do things like eliminate noise, create ambient noise to patch holes, and do equalization matching on a clip-by-clip basis.

Whether you use one application or many, all of a program's elements come together in your edited sequence, helping to guide your editorial decisions as you work to complete the program's content.

For more information about how Final Cut Pro works with other Final Cut Studio applications at this stage of the process, see "Integration During Editorial Development."

### **Stage 3: Client Review**

If you're working on a project for a client, frequent and specific feedback is an absolute requirement. If you're working in a supervised session, you can simply play your project from the Final Cut Pro Timeline. However, there are times when you may be working unsupervised, with clients who are remotely located, or when you want to provide a version of the program that can be screened at another location. Final Cut Studio provides many ways of delivering individual clips or entire sequences to clients for remote viewing, such as via a QuickTime movie or DVD, on the web, or even interactively in iChat.

For more information about using Final Cut Pro, Compressor, and DVD Studio Pro to deliver a program for review, see "Client Review."

#### **Stage 4: Finishing**

After a program's story has been edited and the project's content is considered complete, it's time to give the program its final polish and tweaking, appropriately referred to as *finishing*. The first part of finishing, if you've been working on your project using offline-quality media, is to conform your edited sequence to the highest-quality version of the original source media that's available. The best way to do this depends on how the original media was acquired, how you ingested the media, and how carefully you managed the media during editorial development.

If your offline edit combines source media in several different formats, now may be the time to convert any clips that don't match the final sequence settings so that the entire program is easy to output. Compressor has format-conversion capabilities that facilitate this process.

This is also the time when all temporary elements like placeholder titles, offline effects, and other placeholder media must be replaced with their final, online-quality versions. As always, these elements can be created inside of Final Cut Pro or in conjunction with Motion.

Lastly, once your sequence has been carefully reformed and prepared, your program is ready for color correction and the final sound mix. Final Cut Studio has dedicated applications for each of these tasks, appropriately named Color and Soundtrack Pro.

For more information about using Final Cut Pro with Motion, Color, and Soundtrack Pro, see "Finishing."

#### **Stage 5: Mastering**

Mastering is the process of assembling everything your project needs into a single, deliverable bundle for handoff.

In some cases, this process is as simple as making sure that the video and audio elements are assembled into a final sequence for output to tape. In other cases, mastering may involve assembling a much longer list of deliverable media files, including separate versions of the program with and without titles (also called *texted* and *textless* versions), format conversions, closed captioning and subtitle insertion, and alternative audio mixes for different audiences.

For more information about which Final Cut Studio applications can help with these potential mastering requirements, see "Mastering."

#### **Stage 6: Output and Delivery**

Output and delivery is the last stage of the post-production process. As the name implies, it's the process of creating the final, playable media that you then hand off to the client and audience. Output can take many forms: rendering a DPX image sequence for film printing, outputting to an appropriately high-quality tape format, creating a DVD, or compressing your program to a format suitable for web playback.

For more information about how Final Cut Pro, Compressor, DVD Studio Pro, and Color work together to output to any of these delivery media, see “Output and Delivery.”

## Why Design Your Workflow in Advance?

Final Cut Studio provides numerous tools for performing the many tasks that each program requires, along with features for integrating industry-standard, third-party applications into your post-production workflow. A bit of forethought will allow you to use these tools most efficiently and to their best advantage.

What are the advantages of careful attention to workflow design?

### **You'll save money**

Working out what you'll need at each stage of post-production can help you control your post-production budget. As you can imagine, there are many ways of spending money during post-production, whether by renting equipment like video decks for high-end tape ingest, booking time at a facility to do film-to-tape transfers, or hiring talent to perform specialized tasks that are outside your domain of expertise. The workflows you choose have a big effect on how much money you'll spend on these types of details. For example, something as simple as choosing an appropriate ingest strategy can save you money down the road. You can determine the format of video that would be most cost-effective to ingest based on how long it takes for different offline formats to be reconfirmed, the amount and type of disk storage that is available to you, what degree of finishing and what mastering elements your program requires, and the video decks to which you and any facility you're working with have access. During post-production, nearly every choice you make has the potential to impact your budget.

### **You'll save time**

Being careful about your workflow also eliminates unnecessary steps. For example, if you determine that the duration of your program is such that you can fit all the necessary media on your available storage disks, and the acquisition format is easily handled by your system at online quality, you may elect to work right from the beginning at online quality. This simple decision eliminates the entire step of reconfirming offline-quality media to online quality, which can be a significant time savings. However, if you determine that the online-quality media will be so processor- and space-intensive to work with that you'll lose time during editing, it may make sense to go with an offline/online ingest strategy after all.

### **You can focus on being creative, rather than on fixing problems**

Lastly, working out your post-production strategy in advance lets you avoid problems before they come up. For example, if you're working with film that was telecined to video as an inexpensive "one-light" transfer, and you know in advance that you'll be requesting specific sections of the video to be retransferred at "best-light" settings, you can request a telecine log file. You can then import the telecine log file into Final Cut Pro to automatically create a database of the film edge code-to-video timecode correspondences *prior* to editing, so that later it's easy to export a pull list for the retransfer. Neglecting to do this in advance can result in additional steps and potential hassle down the road (time that you'd probably rather spend creating an innovative title sequence in Motion).

## **Types of Overall Workflows**

The following sections offer some generalizations about the most typical workflows you may find yourself pursuing. Whether you're creating a video for the web or finishing a feature destined for theatrical exhibition, one of these workflow templates probably applies to your program.

Each workflow focuses on the most common combinations of acquisition format and delivery medium. Although the steps between ingest and output may vary in their specifics, these workflows are meant to give you an overall look at how to organize your work for any particular program, before sending you to the other chapters in this guide for more information about particular ingest, editing, and finishing workflows.

The workflow overviews that are provided include:

- "Acquired on Video for Output to the Web"
- "Acquired on Video for Output to a Consumer Playback Format"
- "Acquired on Video for Broadcast Delivery"
- "Acquired on Film for Broadcast Delivery"
- "Acquired on Film for Theatrical Exhibition"
- "Acquired via Digital Cinema Camera for Theatrical Exhibition"

## How to Approach Workflow Design

Two of the most important decisions to make are how you want to ingest your media and how you'll output it. These decisions are tightly linked and define everything that happens in between. In general, it's wise to plan your post-production strategy with the end product in mind. What do you expect to deliver at the end of the process? There are far fewer steps involved when you output to videotape than when you output to film, so this decision is crucial.

When you know how you want to output your program, you can pick an editing-to-finishing workflow based on the acquisition format that was used. This will let you know if you need to use an offline-to-online workflow that involves reconfirming the media, or an online-to-online workflow where you output the same media that you originally ingested for editing.

After these decisions have been made, you're in a much better position to determine how best to preserve the quality of your media and all relevant clip metadata, as you edit, reconfirm, and do visual and audio effects work.

## Acquired on Video for Output to the Web

This workflow refers to programs that are acquired via a consumer or professional video format such as DV-25, HDV, AVCHD, or DVCPRO HD and produced for delivery via the web. The results are typically highly compressed and are intended to be watched on a computer, on a portable device (such as iPhone), or on a television via a set-top box of some kind.

### Types of Programs

Program types include video podcasts and blogs, web serials, educational programming, corporate communication videos, Internet-distributed features and TV programs, and music videos. Given the proliferation of video for the web, this category has rapidly expanded to include just about every type of program.

### Typical Acquisition Formats and Means of Ingest

Acquisition formats include but are not limited to DV-25, DVCPRO 50, HDV, AVCHD, DVCPRO HD, and XDCAM, to name a few. What this means for ingest is:

- Tape-based formats are ingested via the Log and Capture window in Final Cut Pro using an appropriate built-in interface (FireWire) or a third-party capture card.
- Tapeless formats (also called *file-based* formats) are typically ingested by copying the native video data from the camera to your storage system and then transferring the video data to Final Cut Pro using the Log and Transfer window.

## Quality-Control Guidelines

An absence of standardization and engineering oversight means that venues hosting web video usually have extremely permissive quality-control standards. Furthermore, computer display of video is simply more forgiving than that of traditional video playback devices. However, it's to your advantage to use color correction to adjust the clips in your program in order to provide your audience with the best possible experience. What this means to you is:

- Although you don't have to legalize your program's picture to exacting video standards, video compression for the web may still clip super-white luma (above 100 percent) and out-of-bounds chroma that go uncorrected, so it's wise to at least adjust your clips to these minimum standards.
- Color correction, even if applied simply inside Final Cut Pro, can dramatically improve the quality and legibility of your images.

## Delivery Specifications

Overall, there are many possible delivery specifications for web video. Frame rates, frame sizes, and media formats vary widely depending on the intended playback platform and application. Common delivery platforms for Internet video include QuickTime, Flash (SWF), and Windows Media. Long-term archiving of the final master is typically accomplished via a high-quality QuickTime file backed up to a variety of media. What this means is:

- You usually create a self-contained QuickTime master of your program.
- You use Compressor, the Share command in Final Cut Pro or Motion, or another third-party video encoding application to prepare a version of your program for the web.

## Workflow Summary

This is one of the most basic and straightforward workflows you can follow. Your video is ingested into Final Cut Pro using the Log and Capture or Log and Transfer window, as appropriate. During editing, you can use Motion and Soundtrack Pro, along with the video and audio effects tools that Final Cut Pro offers, to incorporate motion graphics, effects, and sound work into your program. After editing is complete, you can color correct your project inside Final Cut Pro or send your edited sequence to Color.

After you finish your program, you can use Compressor to export it to a format that's suitable for web delivery and playback.

*Tip:* You can also use the Share command in Final Cut Pro or Motion to export programs directly to web-hosting services such as MobileMe and YouTube. See the Final Cut Pro documentation for more information.

## Acquired on Video for Output to a Consumer Playback Format

This workflow refers to programs that are acquired via any consumer or professional video format and produced for delivery via DVD or Blu-ray for consumer playback.



## Types of Programs

Program types commonly include direct-to-video programming, shorts and features intended for film festival exhibition, corporate communication videos, and educational programming.

## Typical Acquisition Formats and Means of Ingest

Acquisition formats include but are not limited to DV-25, DVCPRO 50, HDV, AVCHD, DVCPRO HD, and XDCAM, to name just a few. What this means for ingest is:

- Tape-based formats are ingested via the Log and Capture window in Final Cut Pro using an appropriate built-in interface (FireWire) or a third-party capture card.
- Tapeless formats (also called *file-based* formats) are typically ingested by copying the native video data from the camera to your storage system and then transferring the video data to Final Cut Pro using the Log and Transfer window.

## Quality-Control Guidelines

Unless programming is being delivered to a formal distributor, quality-control standards tend not to be tightly applied. However, because the exhibition is intended for televisions and video projectors, practical video and audio signal limitations apply if you want to ensure trouble-free playback in the widest variety of situations. What this means to you is:

- You should use reasonable standards when color correcting your program, either in Final Cut Pro or in Color, to ensure consistent playback.
- You don't typically have to be as strict as a broadcaster might require, although it pays to use an appropriate broadcast monitor as you work.

## Delivery Specifications

Delivery is typically in one of the common video formats, including NTSC and PAL frame sizes for standard definition (SD) and 720 or 1080 frame sizes for high definition (HD). Frame rates are usually limited to 23.98 fps (for DVD and Blu-ray authoring), 25 fps for PAL, or 29.97 fps for NTSC. Although the final product is often an authored DVD, it's common to master to a high-quality tape format for long-term archiving. What this means is:

- You usually output a QuickTime master of your program.
- You will probably use Compressor and DVD Studio Pro to author a DVD of your program for direct delivery or replication.
- You may optionally use your QuickTime master to create a Blu-ray version of your program.
- Using Compressor, you can also create versions of your program suitable for high-end digital distribution, such as SD or HD playback on Apple TV or iPhone.

## Workflow Summary

This is one of the most basic and straightforward workflows you can follow. Your video is ingested into Final Cut Pro using the Log and Capture or Log and Transfer window, as appropriate. During editing, you can use Motion and Soundtrack Pro, along with the video and audio effects tools that Final Cut Pro offers, to incorporate motion graphics, effects, and sound work into your program.

After editing, it's a good idea to send your edited sequence to Color for grading, after which you send it back to Final Cut Pro in preparation for output.

When you finish your program, you can use Compressor to export its video and audio to formats that are suitable for DVD authoring using DVD Studio Pro, or to a format that's suitable for Blu-ray authoring using other tools.

**Tip:** You can also use the Final Cut Pro Share command to quickly burn programs directly to DVD or to a Blu-ray disc. See the Final Cut Pro documentation for more information.

## Acquired on Video for Broadcast Delivery

This workflow specifically refers to programs that are acquired via a professional video format and produced for delivery to a network for terrestrial, cable, or satellite broadcast.

### Types of Programs

Program types include network news, daytime TV, music videos, commercial spots, infomercials, magazine shows, reality TV, game shows, and sitcoms. Increasingly, this category includes dramas produced using HD or digital cinema cameras.

### Typical Acquisition Formats and Means of Ingest

Acquisition formats are typically limited to less-compressed formats, and some broadcasters specifically exclude or limit the amount of more highly compressed formats that can be used in a program. Commonly used formats include Digital Betacam, DV-25, DVCPRO 50, DVCPRO HD, XDCAM, HDCAM, and even some digital cinema formats such as REDCODE, to name just a few. Highly compressed formats such as HDV and AVCHD are sometimes specifically excluded or restricted in their use (some quality-control guidelines specify that no more than 25 percent of a program may include a restricted format). What this means for ingest is:

- Tape-based formats are ingested via the Log and Capture window in Final Cut Pro using an appropriate built-in interface (FireWire) or a third-party capture card.
- Tapeless formats (also called *file-based* formats) are typically ingested by copying the native video data from the camera to your storage system and then transferring the video data to Final Cut Pro using the Log and Transfer window.

## Quality-Control Guidelines

Because programs in this workflow are being delivered for broadcast, tight quality-control standards usually apply. (Some networks have more stringent standards than others.)

Although video and audio standards vary by network, submitted programming is always closely scrutinized, and quality-control violations may result in tape masters being rejected by the network, incurring additional costs for the client. Always obtain the specific quality-control (QC) guidelines before finishing any program intended for broadcast.

What this means is:

- You'll use Color, or another high-end grading system, to color correct and legalize your program using an appropriate broadcast monitor.
- You should obtain and follow the quality-control guidelines provided by the network or your distributor as a guide in finishing the program.

## Delivery Specifications

Each network typically has specific required delivery formats, which may include one or more SD and HD formats. Also, networks usually require separate versions of each program with and without titles (also called *texted* and *textless* versions). Inquire in advance about what deliverables are required. What this means to you is:

- SD programs are usually output to Digital Betacam.
- HD programs are typically output to HDCAM, HDCAM SR, or D-5, although some broadcasters use other specific formats for mastering.

## Workflow Summary

Your video is ingested into Final Cut Pro using the Log and Capture or Log and Transfer window, as appropriate. During editing, you can use Motion and Soundtrack Pro, along with the video and audio effects tools that Final Cut Pro offers, to incorporate motion graphics, effects, and sound work into your program.

After editing, it's a good idea to send your edited sequence to Color for grading according to the network's standards, after which you send it back to Final Cut Pro in preparation for output. As part of the finishing process, you send all of your program's audio either to Soundtrack Pro or to a third-party digital audio workstation (DAW) application for final sound design and mixing.

When you finish your program, you output it to one or more tape masters, in the network's format of choice.

## Acquired on Film for Broadcast Delivery

This workflow refers to programs shot on film but transferred to video with the intention of creating a video master for terrestrial, cable, or satellite broadcast. This workflow overlaps with the one specified for programs shot on film for direct-to-video release via a formal distributor.

## Types of Programs

Program types include high-end commercial spots, high-end music videos, dramas, made-for-TV movies, and miniseries.

## Typical Acquisition Formats and Means of Ingest

The acquisition format is typically 16mm or 35mm film (or their Super 16mm and Super 35mm counterparts) via any one of a number of cameras. Before you can ingest film into Final Cut Pro, it must be transferred to a video format, usually via a telecine (a machine that converts film to a video signal, in real time) run by an experienced operator. In general, there are three methods used to transfer film to tape: a one-light transfer, a best-light transfer, or a safety transfer. Each has tradeoffs, and the method you use depends on your budget. What this means for ingest is:

- One-light transfers, though cheapest, usually require a retransfer from the original negative. You need to obtain a telecine log file with which to keep track of what source film negative corresponds to which video clips using Cinema Tools. You have the option to have the final color correction done by the telecine operator.
- Best-light and safety transfers, though more expensive, usually eliminate the need to retransfer from the source negative. You have the option to grade your final program using Color, or another third-party color correction environment, as part of your finishing workflow.
- Telecined film is typically transferred to a high-end, tape-based format at SD or HD resolutions.
- Typical video formats used include Digital Betacam, HDCAM, D-5, and HDCAM SR, though you can specifically request other formats. You ingest using the Log and Capture window in Final Cut Pro.

## Quality-Control Guidelines

Because programs in this workflow are being delivered for broadcast, tight quality-control standards usually apply. (Some networks have more stringent standards than others.) Although video and audio standards vary by network, submitted programming is always closely scrutinized, and quality-control violations may result in tape masters being rejected by the network, incurring additional costs for the client. Always obtain the specific quality-control (QC) guidelines before finishing any program intended for broadcast. What this means is:

- You'll use Color, or another high-end grading system, to color correct and legalize your program using an appropriate broadcast monitor.
- You should obtain and follow the quality-control guidelines provided by the network or your distributor as a guide in finishing the program.

## Delivery Specifications

Each network typically has specific required delivery formats, which may include one or more SD and HD formats. Also, networks usually require separate versions of each program with and without titles (also called *texted* and *textless* versions). Inquire in advance about what deliverables are required. Programs intended for broadcast invariably are mastered to a high-end, tape-based format. What this means to you is:

- SD programs are typically output to Digital Betacam.
- HD programs may be mastered to HDCAM, HDCAM SR, or D-5.

## Workflow Summary

First, the film negative is transferred to videotape. The facility that does the transfer will provide you with a telecine log in one of several formats. (FLEx and ALE are common formats that are compatible with Final Cut Pro and Cinema Tools.) You import this log into Final Cut Pro by choosing File > Import > Cinema Tools Telecine Log, which creates a Cinema Tools database of events that establishes the correspondence between the edge code that identifies each frame of film negative and the timecode that identifies each frame of transferred video. This is an optional step, but important if you plan to retransfer any of your edited selects later.

This process also automatically creates offline clips in the Browser. One clip is created for each event in the database. You then use these offline clips to automate the process of ingesting the transferred videotapes via the Log and Capture window. If necessary, you can use Cinema Tools to remove 3:2 pull-down from the imported media, so you can edit at a true 23.98 fps progressive frame rate. This last step is also optional, depending on the frame rate you prefer to work at and the frame rate of the master you'll eventually be outputting.

Your video is ingested into Final Cut Pro using the Log and Capture window. During editing, you can use Motion and Soundtrack Pro, along with the video and audio effects tools that Final Cut Pro offers, to incorporate motion graphics, effects, and sound work into your program.

After editing, it's a good idea to send your edited sequence to Color for grading according to the network's standards, after which you send it back to Final Cut Pro in preparation for output. As part of the finishing process, you send all of your program's audio either to Soundtrack Pro or to a third-party digital audio workstation (DAW) application for final sound design and mixing.

When you finish your program, you output it to one or more tape masters, in the network's format of choice.

## Acquired on Film for Theatrical Exhibition

This workflow refers to programs shot on film and then mastered and output for theatrical exhibition via film or digital projection. Color correction and film output may be accomplished either by conforming the negative and using optical printers or through a digital intermediate process and film printer.

### Types of Programs

Program types include advertising spots, shorts, and features intended for theatrical exhibition.

### Typical Acquisition Formats and Means of Ingest

The acquisition format is typically 16mm or 35mm film (or their Super 16mm and Super 35mm counterparts) via any one of a number of cameras. Before you can ingest film into Final Cut Pro, it must be transferred to a video or QuickTime format that Final Cut Pro can work with. How you choose to transfer your film depends on how you intend to finish the program.

- If you intend to conform the negative and have your program optically color-timed and printed, you must first have the film telecined (transferred to video in real time). Afterward, you're provided with the transferred media and an accompanying telecine log file, which you can use with Final Cut Pro and Cinema Tools to track the data that allows you to ingest and edit in Final Cut Pro. At the end of this process, you use this data to export a negative cut list with which to conform the camera negative to match your edited video.
- If you intend to finish via a digital intermediate workflow using Color, you can have the film transferred using a datacine process, where each film frame is scanned into a high-bandwidth image sequence format such as DPX or Cineon. Each frame file's number is converted to timecode and stored in the frame file's metadata. You can then convert each image sequence to an offline- or online-quality QuickTime file for ingest into Final Cut Pro. At the end of the process, you can reconform your edited sequence to the original media using Color for grading and output.
- You can also use a combination of these workflows to suit your particular purpose. For more information, see the Color documentation.

### Quality-Control Guidelines

Whether your program is intended for film or digital projection, quality-control standards are usually extremely specific in order to maintain color fidelity from the negative through to the final distribution prints or digital masters that are sent to theaters. Color and quality-control issues are typically worked out through the efforts of the facilities that do the grading, film output, and/or digital mastering. What this means is:

- You'll use Color, or another high-end grading system, to color correct your program.
- You need to carefully calibrate an appropriately high-end monitor using LUT profiles.

- It's best if you coordinate your efforts with the facility that is printing or mastering the final project.

### **Delivery Specifications**

A program's distributor usually provides the exact delivery specifications that are required. Delivery specifications for film projection include 24 fps playback, specific aperture sizes and aspect ratios, and specific audio encoding methods. Delivery specifications for digital projection are defined by the Digital Cinema Distribution Master (DCDM) encoding specification, which includes specific color space encoding standards and 2K and 4K frame sizes. What this means to you is:

- If you're delivering 2K or 4K image data, you typically deliver a DPX image sequence.
- In some instances, it might also be possible to provide your 2K or 4K program master as a QuickTime file using the Apple ProRes 4444 codec. (Check ahead first.)
- If you're delivering your program at 720p or 1080p resolution, you may be able to deliver an HDCAM SR or D-5 tape master.

### **Workflow Summary for Negative Conforming and Optical Printing**

If you intend to go through a conventional negative conform and optical film–printing process to finish your film, you use Cinema Tools both prior to capture and after you've locked the edit.

First, you usually transfer the film negative to videotape for offline editing. The facility that does the transfer will provide you with a telecine log file in one of several formats. (FLEx and ALE are common formats that are compatible with Final Cut Pro and Cinema Tools.) You import this log into Final Cut Pro by choosing File > Import > Cinema Tools Telecine Log, which creates a Cinema Tools database of events that establishes the correspondence between the edge code that identifies each frame of film negative and the timecode that identifies each frame of transferred video.

Importing the telecine log also automatically creates offline clips in the Browser. One clip is created for each event in the database. You then use these offline clips to automate the process of ingesting the transferred videotapes via the Log and Capture window. If necessary, you can use Cinema Tools to remove 3:2 pull-down from the imported media, so you can edit at a true 23.98 fps progressive frame rate.

You use this ingested media to do the offline edit. After editing is complete, you can export a cut list directly from Final Cut Pro that you can give to a negative cutter to do the final negative conform. From the conform process through the optical grading and printing processes, you work with a lab to obtain the final film deliverables.

## Workflow Summary for Digital Intermediate Finishing and Film Printing

If you intend to use a digital intermediate workflow to finish your program, there are several approaches you can take. The easiest, from a workflow perspective, is to transfer the camera negative via a datacine (a device that scans each frame of film as an uncompressed image file) to create DPX image sequences of all the shots you want to edit. These shots are organized into directories, named with the number of the film roll from which the shots originated. Also, each frame of every image sequence should have embedded timecode metadata that reflects its frame number.

You can then convert the DPX media to offline QuickTime media with matching reel numbers and timecode using Color, which clones the timecode and roll numbers from the DPX media as part of the process. These offline clips are then imported into Final Cut Pro and used to perform the offline edit.

After editing is complete, you export an EDL from Final Cut Pro for use by Color in conforming the original DPX media to your edited sequence. You then grade your program in Color. When grading is complete, the entire program is rendered and output from Color as a single DPX or Cineon image sequence, which is delivered to a film-printing facility.

*Tip:* Another possible workflow is to use Color to convert the scanned DPX image sequences to Apple ProRes 4444 media, and to then create offline QuickTime media from that. Although lightly compressed, Apple ProRes 4444 is a high-quality RGB 4:4:4 data format suitable for film mastering, and you may find the eventual reconform workflow to be simpler to manage using QuickTime media rather than image sequences. If you use Color to do this conversion, make sure to save and keep the project file that you used to do the conversion, in case you need to reconvert the original DPX media with the same filenames that Color automatically generated originally.

## Acquired via Digital Cinema Camera for Theatrical Exhibition

This workflow refers to programs shot with digital cinema cameras, typically at HD through 4K resolutions, and then mastered and output for theatrical exhibition via film or digital projection.

### Types of Programs

Program types include advertising spots, shorts, and features intended for theatrical exhibition.

### Typical Acquisition Formats and Means of Ingest

The acquisition format is captured using a digital cinema camera such as the Thomson Viper FilmStream, Panavision Genesis, RED ONE, and Arriflex D-21, among others. There are several ways in which these cameras record images. What this means for ingest is:

- Some digital cinema cameras record at HD resolutions using the HDCAM SR tape format, necessitating a tape-ingest workflow in Final Cut Pro.



- Other digital cinema cameras, such as the RED ONE, record 2K and 4K resolution image data using a proprietary RAW format. The RED Digital Cinema Camera Company provides plug-ins for Final Cut Studio that enable specialized ingest and finishing workflows. Other manufacturers rely on proprietary image-processing utilities to convert their format to one useful to Final Cut Studio applications.
- Still other digital cinema cameras record images as DPX image sequences. This workflow is similar to a film digital intermediate workflow; you can use Color to convert the source DPX image sequences to online or offline QuickTime media for ingest and editing in Final Cut Pro, and later, finishing (with the option to reconfirm to the original DPX image sequences in Color, if necessary).

### **Quality-Control Guidelines**

Whether your program is intended for film or digital projection, quality-control standards are usually extremely specific in order to maintain color fidelity from the negative through to the final distribution prints or digital masters that are sent to theaters. Color and quality-control issues are usually worked out through the efforts of the facilities that do the grading, film output, and/or digital mastering. What this means is:

- You'll use Color, or another high-end grading system, to color correct your program.
- You need to carefully calibrate an appropriately high-end display using LUT profiles.
- It's best if you coordinate your efforts with the facility that is printing or mastering the final project.

### **Delivery Specifications**

A program's distributor usually provides the exact delivery specifications that are required. Delivery specifications for film projection include 24 fps playback, specific aperture sizes and aspect ratios, and specific audio encoding methods. Delivery specifications for digital projection are defined by the Digital Cinema Distribution Master (DCDM) encoding specification, which includes specific color space encoding standards and 2K and 4K frame sizes. What this means to you is:

- If you're delivering 2K or 4K image data, you'll typically deliver a DPX image sequence.
- It might also be possible to provide your 2K or 4K program master as a QuickTime file using the Apple ProRes 4444 codec. (Check ahead first.)
- If you're delivering your program at 720p or 1080p resolution, you may be able to deliver an HDCAM SR or D-5 tape master.

## Workflow Summary

Digital cinema cameras typically shoot tapeless media (although some filmmakers record to HDCAM SR), so the specific method of ingest depends on the exact type of media that was originally captured. Usually, this includes proprietary RAW formats (such as the RED ONE camera's REDCODE format) or DPX image sequence capture. REDCODE media can be ingested into Final Cut Pro using third-party software, and other RAW formats can usually be converted to a suitable QuickTime file format for editing via proprietary software. DPX image sequences, on the other hand, can be converted to QuickTime media using Color for offline editing in Final Cut Pro.

After editing is complete, the edited sequence must be prepared, and all offline media must be reconformed to the original online source media using one of a variety of methods. REDCODE media can be reingested as native RED QuickTime files in preparation for grading in Color, and DPX source media can be conformed using an EDL exported from Final Cut Pro using Color. When grading in Color is complete, the entire program is rendered and output from Color as a single DPX or Cineon image sequence, which is then delivered to a film-printing facility.

*Tip:* If you're working with media that was captured as DPX image sequences, you can use Color to convert the DPX media to Apple ProRes 4444 media and then use the Media Manager in Final Cut Pro to create offline QuickTime media from that. Although lightly compressed, Apple ProRes 4444 is a high-quality RGB 4:4:4 data format suitable for film mastering, and the eventual reconform process is simple to manage. If you use Color to do this conversion, make sure to save and keep the project file that you used to do the conversion, in case you need to reconform the original DPX media with the same filenames that Color automatically generated originally.

This chapter covers the following:

- What Is Ingest? (p. 27)
- Importing Information to Aid in Capturing (p. 29)
- Choosing the Best Ingest Strategy for Your Workflow (p. 30)
- Ingest Methods Based on Media Type (p. 32)
- Asset Management and Organization (p. 44)

This chapter covers the myriad ways in which you can ingest media into the Final Cut Studio applications for editing, motion graphics work, and sound design. Ingesting into Final Cut Pro is covered most extensively, as most audiovisual projects begin in this application.

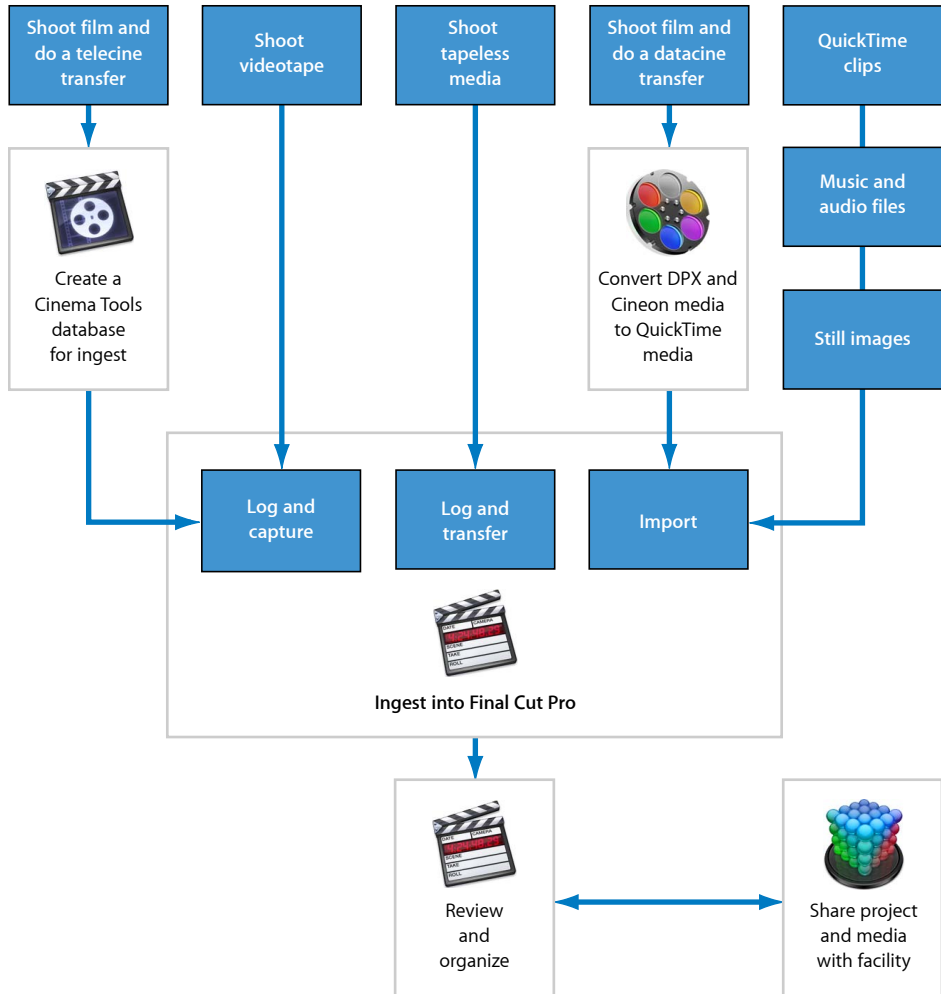
## What Is Ingest?

Before you can work with media in Final Cut Studio, you need to get it onto your hard disk and into Final Cut Pro. *Ingest* describes, in a very general sense, the process of capturing, transferring, or otherwise importing different types of video, audio, or image media into Final Cut Pro in order to use it in a program. Once in Final Cut Pro, media can be easily moved into any of the other Final Cut Studio applications.

There are three primary ways of ingesting media into Final Cut Pro:

- *Log and Capture window:* You use the Log and Capture window to capture standard definition (SD) and high definition (HD) media from a tape-based format, in real time.
- *Log and Transfer window:* You use the Log and Transfer window to capture tapeless media in a wide variety of formats, including SD, HD, and even some 2K and 4K formats.
- *Import Files or Import Folders:* You use the Import Files and Import Folders commands to import other kinds of QuickTime, audio, and image file formats, as well as compatible Final Cut Studio project and data files.

However, this is only part of the story. Depending on the type of media you're ingesting, other applications such as Cinema Tools and Color might play a part in the ingest process. Workflows for ingesting film-originated media, in particular, can be more involved depending on how important it is to be able to match back to the original film negative and whether the film negative was transferred to videotape or DPX or Cineon image sequences. The following flow chart illustrates the different paths media might take into Final Cut Pro.



You can also import video, audio, and still-image files directly into other Final Cut Studio applications such as Motion and Soundtrack Pro, but video capture and transfer is limited to Final Cut Pro, and audio capture is limited to Final Cut Pro and Soundtrack Pro.

## Importing Information to Aid in Capturing

There are three ways in which you can import organizational information into Final Cut Pro that will help you prepare for ingest. The method that best fits your particular workflow depends on the type of media you're ingesting and how much preparation you want to do in advance.

### Import batch capture lists

A *batch capture list* is a tab-delimited text file that specifies which clips you want to capture from a particular videotape using timecode. Each clip is defined, at a minimum, by a name, a reel number, and timecode In and Out points. Batch capture lists are useful because anyone can review video dailies on tape, on DVD, or in QuickTime Player and, using timecode as a reference, assemble a list of which clips to ingest without having to know how to use Final Cut Pro.

You can create a batch capture list using any spreadsheet, text editor, or database application as long as you can export a tab-delimited plain text file when you're finished. This file can then be imported into Final Cut Pro, which turns each entry in the list into an offline clip in the Browser, ready for capture.

For more information, search for "batch list" in Final Cut Pro Help.

### Import XML-based batch capture lists from Cinema Tools

Another option is to export an XML-based batch capture list from Cinema Tools and then import it into Final Cut Pro. This option is appropriate for any workflow in which you want to maintain the correspondence between the original film negative and the video that was transferred from it. This method is ideal when, at the end of the post-production process, you want to conform the original negative or retransfer new, high-quality media from the source negative for finishing.

This workflow assumes that you're starting out with a Cinema Tools database created from an imported ATN, FLEx, FTL, or ALE telecine log file provided by the facility that did the film-to-video transfer. FLEx and ALE files contain a wealth of information about the keycode that identifies the frames of film negative that were transferred, the corresponding video timecode, and other logging information such as film type, camera roll, telecine speed, and sometimes even notes from the shoot. You import this log into Final Cut Pro by choosing Import > Cinema Tools Telecine Log, which creates a Cinema Tools database of events that establishes the correspondence between the edge code that identifies each frame of negative and the timecode that identifies each frame of transferred video. This process also automatically creates offline clips in the Browser, which contain all of this information.

You can also import compatible telecine log files directly into Final Cut Pro by choosing File > Import > Cinema Tools Telecine Log, which automatically creates a Cinema Tools database.

For more information, search for “batch capture list” in Cinema Tools Help.

### **Import Edit Decision Lists**

You can also import an Edit Decision List (EDL) into Final Cut Pro to use as a starting point for ingesting media. An EDL is a text file that describes an edited project as a series of events. Events can include cuts, transitions, and sometimes superimpositions that make up an edit. When you import an EDL, you end up with an edited sequence and a bin in the Browser named Master Clips that contains each offline clip, ready for recapture. EDLs are useful for moving projects from other editing environments into Final Cut Pro, if there’s no other XML-based solution or third-party utility for doing so.

For more information, search for “importing EDLs” in Final Cut Pro Help.

## **Choosing the Best Ingest Strategy for Your Workflow**

The way you ingest your media affects the way you’ll work with it during editorial development as well as what additional steps you’ll need to perform in order to finish and master your program. One of the most fundamental workflow decisions you have to make is whether to work in an offline/online manner or ingest your media at online quality right from the beginning and work at full quality all the way through the finishing process.

No matter what kind of media you use, there are three general approaches to ingesting and working with your media.

### **Ingest, edit, and finish at online quality**

Using this strategy, you ingest all of your media at its highest native level of quality. You edit at this quality, and when you’re ready, you finish your project by color correcting and mastering it using the same media that you originally ingested. All the way through your project’s development, you’re working with your media at its most pristine.

Ingesting all your media at its highest quality means that when you’re ready for finishing, there’s no need to reconfirm, which saves time. However, this can require large amounts of disk space, especially for uncompressed HD, 2K, and 4K formats. Furthermore, some video formats are processor-intensive and reduce real-time performance while you’re editing, which can slow you down.

Whether or not this method works for you depends on the type and amount of media that was originally acquired. For example, the source footage for shorter projects or those using a compressed acquisition format (such as DV-25, HDV, or DVCPRO HD) can be realistically captured in its entirety at the highest native level of quality. On the other hand, projects that have a large amount of source material (for example, documentaries with hundreds of hours of footage) and use a high-bandwidth format (such as the Uncompressed 10-bit or Apple ProRes 4444 codec) may be more difficult to manage this way.

### **Ingest at online quality, edit using duplicate offline media, and reconform to online media for finishing**

This strategy is typical for many programs whose media was acquired using a tapeless recording format. Using this method, you copy or ingest all of your recorded media at its highest native level of quality and then immediately back it up for safety. You then create a second set of lower-quality media files, using either the Log and Transfer window or the Media Manager (depending on the format of media you're working with). This duplicate offline media has cloned timecode, clip names, reel names, and UUIDs (or Universally Unique Identifiers; see "Ingesting Tapeless Media") that are identical to those in the source media. You edit your program using the offline media, which typically results in better performance, allowing you to work more efficiently.

When you're ready to finish, you reconform your program to the online media that you originally ingested. Because the online media is already on your hard disks, the reconform process should be relatively easy, and you can color correct, master, and output your program at this high quality.

This method of working requires large amounts of disk space because you need to maintain both the online and offline versions of media. However, often the online media is stored on one system and the offline media is used on an entirely different computer. The online-to-offline conversion can be time-consuming but happens only once at the very beginning of the process, and makes it faster and easier to reconform later, when you frequently have less time. In the interim, offline media lets you use a less expensive computer to do the majority of your work.

**Note:** Although this is the only way to work with tapeless media, this method can be used with any type of captured media.

### **Ingest and edit at offline quality and reconform to online quality for finishing**

This strategy is typical for programs whose media was acquired using high-bandwidth, tape-based formats. Using this method, you ingest your media at offline quality and do your entire offline edit using this low-quality, low-bandwidth media. When you're ready to finish your program, you recapture only the media that is used in the final program from the source videotapes at online quality, and from this point forward you color correct, master, and output your program at high quality.

When you use this method, the initial ingest is usually fast and has minimal disk space requirements. However, you need to budget both time and equipment for the eventual process of reconforming from the source tapes. As always, the key to a successful reconform in this scenario is to carefully maintain the timecode and reel identification of each clip in your project, as these two pieces of data are key in maintaining the correspondence between the offline and online media. Archiving the source media, especially with tapeless formats, is critical.

## Ingest Methods Based on Media Type

The type of acquisition format you work with determines the ingest method used by the specific Final Cut Studio application. Most tape-based or tapeless acquisition formats must be captured or transferred using Final Cut Pro. Other formats, including QuickTime media, still-image files, and audio files, can be imported directly into any of the Final Cut Studio applications that are capable of using them.

The following ingest methods are described here:

- “Ingesting Tapeless Media”
- “Ingesting Tape-Based Media”
- “Ingesting Film Transferred to Video”
- “Ingesting Film Transferred as DPX or Cineon Image Sequences”
- “Ingesting Audio”
- “Ingesting Individual Still Images”
- “Ingesting Animation and Broadcast Design Files”

For more information about the formats covered in the above sections, see *Professional Formats and Workflows*, available in Final Cut Pro Help.

### Ingesting Tapeless Media

Tapeless media formats (also called *file-based* formats) are increasingly popular for acquisition, and, in fact, most new video and digital cinema formats being introduced are tapeless. Tapeless acquisition usually requires the Log and Transfer window in Final Cut Pro; some formats that aren't supported directly by Final Cut Pro can be converted to a supported QuickTime format using a third-party utility.

#### Popular Formats

Popular tapeless formats that Final Cut Studio is compatible with include P2, AVCHD, AVC-Intra, IMX, XDCAM, XDCAM HD, XDCAM EX, and REDCODE (which requires additional third-party software).

#### Method of Ingest

All tapeless formats are ingested using the Log and Transfer window in Final Cut Pro. The media you want to ingest needs to be on a mounted storage device prior to transfer.

#### Clip Organization

Before you begin the transfer process, you need to decide what media you want to archive for the long term (preferably by backing it up in two separate places). It's usually wise to archive everything that was originally shot, and it's critical to preserve the original directory structure of each set of media that you copy from the camera's recording media.



During the log and transfer process, you have several options for organizing your media. You can choose specific source media to ingest and add logging information, including clip name, scene number, shot/take number, camera angle, log notes, and a “good” flag that you can use to indicate preferred selects.

### **Tracking and Organizational Information**

The most important piece of organizational metadata that Final Cut Pro uses for ingested tapeless media is a Universally Unique Identifier (UUID). Every clip that’s ingested from a tapeless media format is assigned a UUID number that, along with each clip’s timecode track, maintains the correspondence between the ingested clip and the original source media file it was derived from.

Additional camera-specific metadata may also be available, depending on the format. Usually proprietary metadata can be accessed only by using third-party utilities. Consult your camera’s documentation for more information, if necessary.

### **Backup and Archiving Considerations**

It’s critical to redundantly archive all of the source media, along with the original directory structure that was copied from the camera’s storage media. Hard disk backup to multiple volumes is a good short-term solution, and optical or tape data backup may be the most suitable long-term solution.

### **Common Offline/Online Strategies**

Some formats, such as AVCHD, must be transcoded to another format (such as Apple ProRes) when ingested into Final Cut Pro. Others, like P2, XDCAM, and REDCODE, can be ingested natively. Native ingest usually involves embedding the native source media in a QuickTime wrapper. As a result, the media remains in its native format but appears to Final Cut Studio applications as a QuickTime file.

If you’re working with a low-bandwidth format, it may be simplest to ingest at full quality and then edit and finish at the same high quality.

Alternatively, you can transcode to an offline format during ingest. Because each tapeless clip’s UUID allows you to match each ingested offline clip to the original source media file, you can always reingest later at a higher quality for finishing.

## **Ingesting Tape-Based Media**

Videotape capture is as basic as it gets, and Final Cut Pro is capable of ingesting virtually every videotape format using built-in or third-party video capture interfaces. Although tapeless formats are quickly taking over acquisition, tape-based formats still dominate the final process of high-end mastering.

### **Popular Formats**

Popular SD formats include the analog Betacam SP format and the digital DV-25, DVCAM, DVCPRO, DVCPRO 50, Digital Betacam, and Betacam SX formats.

Popular HD formats include DVCPRO HD, HDCAM, HDCAM SR, and D-5.

### **Method of Ingest**

All tape-based formats are ingested using the Log and Capture window in Final Cut Pro. Some formats, like DV-25, DVCPRO 50, and DVCPRO HD, can be captured directly via a FireWire interface. Others require the use of a third-party video capture interface for capture of composite, S-Video, component Y'P<sub>B</sub>P<sub>R</sub>, SDI, or HD-SDI video signals.

### **Clip Organization**

Before you capture, you can create a batch capture list that specifies the reel number and timecode of each tape so that you can choose, in advance, which clips you want to capture. (See “Import batch capture lists” for more information.) Once you begin the log and capture process, there are two ways you can capture your media:

- You can capture entire tapes of media at once, as long as you have enough storage space. You can then organize your media later, in the Browser.
- Alternatively, you can selectively log the shots you want in advance, capturing only the media you know you want to use and saving hard disk space.

### **Tracking and Organizational Information**

The three most critical pieces of metadata include the clip name you assign, the reel number that matches each clip to the source videotape, and the timecode track that identifies which range of media came from what part of the source videotape.

When using tape-based formats, metadata management is a manual process. Each videotape should be physically labeled with the reel name, and it's important to make sure that each clip is logged with the correct reel number. Accurate timecode control is also critical.

### **Backup and Archiving Considerations**

One of the nice things about videotape formats is that the source tapes are their own backup. Some producers also opt to clone the source tapes for offsite storage for an added level of security. If you do this, make sure the timecode is accurately cloned and the reel numbers are accurately and physically marked on each tape.

### **Common Offline/Online Strategies**

In order to work quickly and save hard disk space, many editors capture media for the initial offline edit using a low-quality codec and then later recapture only the clips that were used in the edit using a high-quality online codec, in preparation for finishing and mastering.

If you're worried you won't have the time or budget to get access to the deck in the future, you can capture at online quality right from the start. This method is increasingly popular for highly compressed acquisition formats like DVCPRO HD. These formats have low bandwidth requirements, allowing for capture at the highest native quality of the source media, with little overhead, and giving you the freedom to work at this quality all the way through to mastering.

If you're ingesting at online quality from the very beginning, but the resulting media is too bandwidth-intensive to conveniently edit on your particular system, you can use the Media Manager to create duplicate offline media with cloned timecode and reel names for offline editing.

## Ingesting Film Transferred to Video

If you're working on a project that was shot on film, you need to transfer the camera negative to a video format suitable for your workflow. If you want to work using a conventional video format, the transfer is typically done using a telecine. Telecines are machines capable of converting the negative image to a video signal in real time, in the process cropping and resizing the image to the appropriate resolution and converting the frame rate as necessary to record to the video format you require.

The way you choose to have the film transferred depends largely on your budget, your intended workflow, and the level of quality that's necessary at each stage of your post-production workflow. In terms of translating the film frame into a video image, there are three general methods of managing the color and contrast of the final result.

- *One-light transfer:* This is the most inexpensive way of transferring the negative. The footage you choose is transferred quickly, using the least possible number of adjustments (hence the name—one lighting adjustment for an entire roll of film) to achieve reasonably good-looking video. This method is good for obtaining offline-quality media for editing, but you usually need to retransfer from the original negative to obtain maximum quality. The advantage is that after editing, there's usually much less footage to transfer, which saves time and money. Using this method, you request a telecine log that you can import into Final Cut Pro (or Cinema Tools) to track the correspondence between your offline media and the original film negative. (The ATN, FLEx, FTL, and ALE telecine log formats are compatible with both Final Cut Pro and Cinema Tools.)

- *Safety transfer:* Safety transfers are extremely conservative, with the camera negative being transferred as neutrally as possible. The emphasis is on maximizing the amount of color and contrast within the widest available dynamic range of the video recording format, while avoiding clipping in the highlights and shadows as much as is reasonable (although some highlights, like direct light sources, sun glints, and lighting reflections, should be clipped). Creative adjustments are usually not made, and although the resulting video image often looks a bit dull, the video signal has the maximum amount of image data for doing high-quality color correction later. If you're ultimately mastering to videotape, doing a safety transfer of all the footage you intend to use ensures that you don't have to retransfer your material after you finish editing. If you plan to color correct the material during the finishing process, a safety transfer gives you the most flexible image for making your final adjustments.
- *Best-light transfer:* The opposite of a one-light transfer, a best-light transfer is the most time-consuming and expensive method of transfer. Each section of film is transferred with individual settings, as necessary. Time is taken to do careful grades and creative adjustments. Best-light transfers usually take place when the footage is being retransferred after the offline edit has been completed, but sometimes best-light transfers are done right from the beginning of the process, to ensure that the footage looks its best from offline through online.

### **Popular Formats**

Film is typically transferred to high-quality tape-based formats suitable for mastering, including Digital Betacam, HDCAM, HDCAM SX, and D-5, although other formats may be used for specific applications. Transfer to tapeless formats is becoming increasingly available. If you have a choice, you should decide whether you want to manage physical videotapes or volumes of digital media files.

### **Method of Ingest**

If you're ingesting a low-quality transfer with the intention of retransferring later, or if you plan to output a cut list for an eventual negative conform, you need to have the transfer facility provide you with a telecine log file to import into Final Cut Pro (or Cinema Tools). Final Cut Pro uses this list to create a Cinema Tools database, along with a set of offline clips that you use to capture the transferred video. All of the necessary film metadata is tracked automatically. If you're ingesting a transfer that was done at its final quality so there's no need for a retransfer, this step isn't necessary.

To actually ingest the media, you use the Log and Capture window, as with any tape-based format. See "Ingesting Tape-Based Media" for more information.

### **Clip Organization**

Organization happens during the telecine session, when you initially decide what footage to transfer. Typically, each camera roll of film is transferred to a new reel of videotape. (Each reel of tape usually starts at a new hour.)

Sometimes, to save on tape costs, multiple rolls are transferred to a single 60-minute tape. For 35mm film, each subsequent roll is transferred in 15-minute increments. For example, the first roll is transferred starting at 01:00:00:00, the second roll is transferred starting at 01:15:00:00, the third roll starts at 01:30:00:00, and the fourth roll starts at 01:45:00:00.

In the case of 16mm film, you can request that multiple camera rolls be assembled onto consolidated lab rolls by the lab doing the developing. Each lab roll is then treated as a single continuous roll, which can be transferred to a single 60-minute tape with ease.

After every roll of film has been transferred to a reel of tape, ingest and organization are the same as with any tape-based format. See “Ingesting Tape-Based Media” for more information.

### **Tracking and Organizational Information**

During the transfer, a *marker frame* (also referred to as a *lab roll hole*, *head punch*, or *punch hole*) is assigned to each roll of film at a point before the first shot begins, with a hole punch permanently identifying that frame. The marker frame is assigned the timecode value of XX:00:00:00 (where XX is an hour value that is incremented for each subsequent camera roll being transferred). The marker frame creates an absolute timecode reference for each frame of film on that roll. The marker frame also sets up a permanent film frame-to-timecode reference that defines the timecode that’s recorded to tape and that is essential for accurately retransferring the film later.

As with any tape-based format, the three most critical pieces of metadata include the clip name you assign during capture, the reel number that matches each clip to the source videotape (and by extension, the roll of camera negative), and the timecode track that identifies which range of media came from what part of the source videotape. Accurate timecode control is critical, as is keeping careful track of reel numbers.

If the transfer is being done strictly for offline editing, you can ask for a window burn that displays both timecode and edge code. If you’re transferring film to a video format with a 4:3 aspect ratio, you can have this window burn made in the black letterboxed area so it doesn’t obscure the image. It may also be possible to write the edge code number of the source film to the user bit of VITC timecode for electronic tracking. Ask the facility doing the transfer what would be best for your situation.

Additionally, you have the option of tracking film-specific metadata by importing telecine logs (such as FLEx and ALE files) into Final Cut Pro (or Cinema Tools) to create a database that allows you to track the correspondence between the reel and timecode numbers of your videotapes and the roll and edge code numbers of the source camera negative. This is important if you’re editing transferred videotape with the intention of conforming the original negative, retransferring best-light selects, or doing a datacine transfer of your program’s selects to DPX or Cineon image sequences for digital intermediate grading and finishing.

Another advantage to importing telecine logs is that other logging information, such as film type, camera roll, telecine speed, and sometimes even the script supervisor's notes from the shoot, is included. Ask the facility doing the transfer what options are available.

### **Backup and Archiving Considerations**

One of the nice things about videotape formats is that the source tapes are their own backup. Some producers also opt to clone the source tapes for offsite storage for an added level of security. If you do this, make sure the timecode is accurately cloned and the reel numbers are accurately and physically marked on each tape.

Of greater importance is the careful storage and preservation of the original camera negative. If you have questions, discuss them with your lab or transfer facility.

### **Common Offline/Online Strategies**

If you're capturing film that was transferred at the best possible quality (a best-light or safety transfer) for a project that's being mastered to videotape, you can work as you would with any other program using videotape source media. When you complete editing, you can finish using the transferred media as is.

If you're planning to retransfer the selects used in your edited sequence after the offline edit is complete, you use the Export Cinema Tools Film Lists command to export the information that will be used to retransfer the shots used in the edit. Give this information to the transfer facility, which can do a best-light or safety transfer of your selects onto new tapes with matching timecode. You'll then reingest your program's final media from tape for finishing.

### **Ingesting Film Transferred as DPX or Cineon Image Sequences**

If you're working on a project that was shot on film, you need to transfer the camera negative to a video format suitable for your workflow. If you want to finish your program using a digital intermediate workflow, this is typically done using a film scanner, or *datacine*. Unlike a telecine (see "Ingesting Film Transferred to Video"), a datacine does a slower, high-resolution, frame-by-frame scan of the camera negative, which is not usually done in real time.

The result is usually a series of uncompressed DPX- or Cineon-formatted image sequences at 2K or 4K resolution. Datacine transfers are typically done as neutrally as possible, with an emphasis on maximizing the amount of color and contrast within the available dynamic range of the image format and avoiding clipping in the highlights and shadows. Creative adjustments are not usually made. The resulting scanned image often looks a bit dull but has the maximum amount of image data for doing high-quality color correction later.

Image sequences cannot be used directly with Final Cut Pro but can be converted to either online or offline media that can be matched back to the original media using Color.

### Popular Formats

Scanned film is typically stored as uncompressed 10-bit logarithmic DPX or Cineon image sequences. Both DPX and Cineon are RGB color space formats with 4:4:4 chroma sampling.

### Method of Ingest

There are several ways you can ingest scanned DPX or Cineon image sequences into Final Cut Pro:

- Using Color, you can convert the scanned image sequences to Apple ProRes 4444 media, which you can then use directly for mastering your program.
- Using Color, you can also convert the scanned image sequences to offline QuickTime files using a lower-bandwidth Apple ProRes codec. There are several Apple ProRes codecs to choose from, which lets you strike an appropriate balance between image quality and file size. This approach requires you to reconfirm your program to the original image sequences in Color after you finish editing.
- You can also use a third-party utility to convert each image sequence to a format that's usable in Final Cut Pro.

### Clip Organization

The first round of organization happens during film transfer, when you initially decide what footage to transfer. Afterward, archiving and organizing the resulting DPX or Cineon media is similar to working with tapeless media. It's extremely important that each camera roll be scanned and written to a separate directory that's named after that roll, so that at the end of the process you have a series of separate directories, each corresponding to a roll of camera negative.

After scanning, you should back everything up (preferably in two separate places), and you should maintain the organizational directory structure of the media.

### Tracking and Organizational Information

The organizational data for DPX and Cineon media should be worked out in advance with the facility doing the film-to-data transfer. A typical strategy is to assign a *marker frame* to each roll of film at a point before the first shot begins, with a hole punch permanently identifying that frame. Each roll's marker frame is assigned the timecode value of XX:00:00:00 (where XX is an hour value that is incremented for each subsequent camera roll being transferred). The marker frame creates an absolute timecode reference for each frame of film on that roll.

You should request that the frame numbers incorporated into the filenames of the transferred image files be based on this timecode. Your final DPX or Cineon image sequences will then have frame numbers in the filename that, with a bit of mathematical conversion, match the timecode value in the header information, providing valuable data redundancy.

The most important piece of information for organizing DPX media is the filename of each frame, which includes the frame number that identifies the frame's place in each sequence. For later conforming in Color, DPX filenames must have a prefix, an underscore, a frame number, and a file extension, taking the following form: Filename\_0123456.dpx. Another important piece of information for Final Cut Studio workflows is the name of the directory in which each image sequence is located. Each image sequence should be stored in a directory named with the number of the camera roll the image sequence was scanned from. This is so the directory number can be used as a reel number during conversion to offline QuickTime media, for tracking the correspondence between the frames of the QuickTime media and the original film frames.

Additionally, metadata written into the header of each DPX file provides additional information for image processing and media tracking. This metadata is typically written by the facility doing the transfer and includes the following:

- *Transfer*: Specifies whether the image is linearly or logarithmically encoded. Scanned film frames are typically logarithmically encoded, but Color can work with either linear or logarithmic media.
- *Low Reference*: The numeric value used to identify the black point. For media being printed to film, this value is typically 95 (for logarithmically encoded media).
- *High Reference*: The numeric value used to identify the white point. For media being printed to film, this value is typically 685 (for logarithmically encoded media).
- *Timecode*: For compatibility with the Color method of reconforming DPX media to match an EDL generated by Final Cut Pro, the timecode value written into the DPX header should be derived from that file's frame number. For more information, see the Color documentation.

### **Backup and Archiving Considerations**

Unlike workflows involving tapeless media, film-scan workflows ensure that you always have a backup in the original camera negative. If something happens to your film-scan media, you can always retransfer. However, this will be expensive, so it's best to redundantly archive all of your transferred media, preserving the directory structure you created to organize your media. Hard disk backup to multiple volumes is a good short-term solution, but optical or tape data backup may be the most suitable long-term solution.

### **Common Offline/Online Strategies**

There are many ways of organizing an offline edit and online reconform of scanned DPX media. One of the more straightforward ways of working with DPX or Cineon media in Final Cut Studio is to use Color to generate offline QuickTime clips from the DPX or Cineon source files. During this conversion, each clip's timecode is derived from either the timecode header metadata or the frame number in the filename, and the reel number is derived from the name of the directory in which each transferred image sequence is stored.



After you edit your sequence using these converted QuickTime clips, you then export an EDL from Final Cut Pro, which is used to reconfirm your project to the original DPX or Cineon media in Color. After your program has been reconfirmed, you grade and output your program as a single DPX or Cineon image sequence that can be delivered to a facility for film printing.

For more information about different post-production workflows involving scanned film, see the Color documentation.

## Ingesting Audio

You can capture audio from analog and digital tape, or import various tapeless formats directly into Final Cut Pro for placement in your edited program. For the final mix, you can work inside Final Cut Pro, or you can send your program's audio to Soundtrack Pro to finish it there, where you can import additional digital audio files to add to the mix. For more information about finishing audio, see "Final Sound Editing, Design, and Mixing."

### Popular Formats

Popular digital audio formats compatible with Final Cut Pro and Soundtrack Pro include AIFF, WAVE, Broadcast Wave Format (BWF), Sound Designer II, and QuickTime audio. You can also use MP3 and AAC files, but these require rendering, so media in either of these formats should be converted to AIFF or WAVE prior to import.

### Method of Ingest

You can ingest audio into either Final Cut Pro or Soundtrack Pro, depending on the format of the audio and how you need to use it.

- *Analog and digital tape-based formats:* You can capture audio from any analog or digital tape-based format using a compatible audio interface. Final Cut Pro is capable of recording up to 24 tracks of audio from tape-based formats like DAT, DTRS (which includes decks such as the Tascam DA-88 or DA-98), or ADAT using serial device control for timecode sync and control. If you're using timecode sync, you can capture your media as QuickTime audio files to preserve the timecode sync data. You can also capture up to 24 channels of audio directly into Soundtrack Pro, but you can't capture timecode.
- *Tapeless audio formats:* Audio files such as AIFF and WAVE files are ingested using the Import File or Import Folder command in Final Cut Pro or the Browser in Soundtrack Pro. This includes audio from hard disk recorders, many of which record using the Broadcast Wave Format (BWF), which supports timecode. If you're importing audio from a tapeless device, make sure you mount the recording media and copy all the files you plan on using to your scratch disk *before* importing them into Final Cut Pro or Soundtrack Pro; otherwise, they'll go offline when you unmount the media. If you're importing BWF files into Final Cut Pro, make sure to set the BWF Import setting to Non-Drop or Drop, as appropriate, in the Editing tab of the User Preferences window. BWF files, with accompanying timecode, can also be imported into Soundtrack Pro.

- *Importing audio from CDs:* You can also directly import tracks copied from audio CDs. It's important to copy all the tracks you want to use from the CD to your scratch disk *before* importing them into Final Cut Pro. Otherwise, they'll go offline when you eject the CD.

### Clip Organization

You can use Final Cut Server to organize audio you want to share among multiple users. Locally, audio media is principally organized by filename prior to import. You can use applications such as iTunes or third-party database applications to assemble libraries of music or sound effects with additional organizational data, but this data won't necessarily translate into a format that Final Cut Pro or Soundtrack Pro can use. After the audio media is imported, you can use the Final Cut Pro Browser to add notes and comments to each clip for easier searching and sorting.

*Dual system media*, where the audio and video are captured using separate devices, can be synchronized and put together as merged clips. See the Final Cut Pro documentation for more information.

### Tracking and Organizational Information

QuickTime audio and BWF files support timecode tracks, which are useful for synchronizing audio and video that are recorded on separate sources. All other audio formats are tracked using filename and media duration.

### Ingesting Individual Still Images

Final Cut Pro and Motion both support the import of most popular still-image formats. For the best-looking images, you should consider restricting stills in your project to uncompressed formats such as TIFF. If you use JPEG files, make sure they're saved at high quality to avoid compression artifacts.

Final Cut Pro has no real limit on the resolution of imported still images, and in fact you can use images that are larger than the frame size of your sequence to create pan and scan animations, where you zoom in to or out of an image in either Final Cut Pro or Motion. However, for the sake of rendering efficiency, it's wise to keep the frame size of imported images to a reasonable maximum. In particular, frame size limitations in Color and Motion might affect you if you're sending clips or sequences to either application:

- Color is limited to a maximum frame size of 4096 x 2304 pixels. If you're importing a still image into a Final Cut Pro sequence that you intend to send to Color, you should either limit the image file's frame size to these dimensions or be prepared to replace the image with a version of the clip that is exported as a self-contained QuickTime movie before you send your program to Color.
- Motion supports resolutions up to 8K, although the maximum resolution that's supported on your computer depends on the amount of VRAM of your graphics card, the bit depth of your project, and the number of displays you're using. It's more realistic to limit the resolution of your images to 4K or lower.

### Popular Formats

Final Cut Pro and Color support a wide range of image file formats. The most popular include TIFF, PICT, TGA, and JPEG. If you're planning to use JPEG files, it's best to use the least amount of compression possible to avoid artifacts in your final program.

Final Cut Pro and Motion are also capable of using layered or flattened Photoshop files in different ways. See the Final Cut Pro and Motion documentation for more information.

### Method of Ingest

Still images are imported into Final Cut Pro using the Import command. In Motion, you use the File Browser to find media that you want to add to your project.

**Note:** In Final Cut Pro, TIFF, PICT, TGA, and JPEG files are affected by the Imported Still/RGB Video Gamma setting in the Editing tab of the User Preferences window. This preference setting determines the level of gamma that is applied to these clips when they're imported, although you can always change the gamma level setting in the Item Properties or Browser window. For more information, see the Final Cut Pro documentation.

### Clip Organization

You can use Final Cut Server to organize still images to share among multiple Final Cut Pro users. If you organize your images using iPhoto, you can access your albums and library in Motion from within the Library tab. (See the Motion documentation for more information.)

### Tracking and Organizational Information

Still images are tracked by filename.

## Ingesting Animation and Broadcast Design Files

If your program incorporates computer animation, broadcast design, or previously captured archival footage files from a variety of sources, you can import the files directly into Final Cut Pro or Motion as long as they're in a compatible QuickTime format. In addition, Motion is compatible with a variety of image sequence formats. In some cases, you must install third-party QuickTime components to use QuickTime media from other editing and compositing environments.

Other formats can be converted to an appropriate QuickTime codec for your project using Compressor. For more information about format conversion using Compressor, see "Format Conversion When Finishing Mixed-Format Sequences."

## Popular Formats

When you create media in another application that you want to use in Final Cut Pro, it's best to use the highest-quality codec that your system can handle in order to avoid compression artifacts in the final program. An additional consideration, especially for computer-generated imagery (CGI) and broadcast animation, is whether or not you need to preserve an alpha channel in a media file with regions of transparency in it.

- High-quality codecs with alpha channel support for clips with transparency include Animation (8-bit) and Apple ProRes 4444 (10-bit). Both of these are RGB color space, 4:4:4 chroma-sampled formats.
- High-quality codecs with no alpha channel support include 8- and 10-bit Uncompressed, Apple ProRes 422, and Apple ProRes 422 (HQ) (10-bit). All of these are Y'C<sub>B</sub>C<sub>R</sub> color space, 4:2:2 chroma-subsampled formats.

## Method of Ingest

QuickTime files are ingested into Final Cut Pro using the Import command. In Motion, you use the File Browser to find media that you want to add to your project.

**Note:** In Final Cut Pro, clips whose media files are encoded using the Animation and Apple ProRes 4444 codecs are affected by the Imported Still/RGB Video Gamma setting in the Editing tab of the User Preferences window. This preference setting determines the level of gamma that is applied to these clips when they're imported, although you can always change this setting in the Item Properties or Browser window. For more information, see the Final Cut Pro documentation.

## Clip Organization

You can use Final Cut Server to organize still images to share among multiple Final Cut Pro users.

## Tracking and Organizational Information

QuickTime media files are tracked by filename, reel name, and timecode. QuickTime supports additional metadata that may or may not be supported by a particular Final Cut Studio application.

## Asset Management and Organization

No matter how you ingest the media you'll be using for your program, consistent organization of your project and its assets is a vital part of the post-production process. The faster you can find the media you need at any given time, the faster you can work. Furthermore, good organization is critical if you're working in a collaborative environment with multiple editors, motion graphics artists, colorists, and sound designers.

Ultimately, good organization will help you and your collaborators spend more time being creative. For more information, see:

- “Organizing Ingested Media, Project Files, and Other Assets”
- “Organizing Your Project Within Final Cut Pro”
- “Organizing and Sharing Assets Using Final Cut Server”
- “When Is Cinema Tools Involved with Media Organization?”

## Organizing Ingested Media, Project Files, and Other Assets

Asset organization begins when you first start ingesting or importing media for use in one of the Final Cut Studio applications. Ideally, the goal of any organizational strategy should be to centralize every media file used by your project within a clearly identified set of directories associated with that project, located on a reliable set of storage volumes. Here are a few tips to keep in mind.

### Keep your files on a limited set of volumes

Keeping all of your project’s assets on one storage volume (or on a limited set of volumes) makes it easier to search for and relink media whenever the need arises. Typically, the storage volumes used are one or more hard disks or disk arrays that have been identified as scratch disks in the Final Cut Pro System Settings window.

### Create a clear directory structure to sort the different types of media you’re using

When gathering your media together, create a carefully named set of directories with which to sort the different types of media you’ll be using. For example, you might create separate directories for audio files, still-image files, Motion projects, stock footage QuickTime files, and Final Cut Pro project files. This makes it far easier to locate specific items than if you simply copy everything into a single directory as a jumble of files.

### Organize your media before you import it

It’s a good idea to organize all media files you copy onto your hard disks before importing them into one or more of the Final Cut Studio applications, to avoid having to fix broken links when you reorganize your media later.

## Organizing Your Project Within Final Cut Pro

Because Final Cut Pro projects often serve as the hub of all post-production activity, you should make a point of keeping the Browser organized whenever you ingest media into a project. Features that are available for organizing clips in the Browser include bins, informational columns, markers, and logging information. This section presents a few organizational tips to keep in mind. For more information, consult the Final Cut Pro documentation.

### **Create a hierarchy of clearly named bins**

It's important to prevent the Browser from becoming difficult to navigate. You can use bins like folders, to help you organize large numbers of clips into manageable groups. You can create a simple structure for your project, with separate bins for audio clips, video clips, Motion projects, and sequences. You can also use bins to separate the clips you intend to use for individual scenes, or to subdivide audio clips into music, sound effects, and voiceover clips. Whatever bin structure you decide to use, the structure should make it easy to find individual pieces of media quickly.

### **Use log notes and labels in the Browser to help sort and find media**

The Browser in Final Cut Pro is actually a powerful database that lets you add complex information to every clip in your project. When you display items in the Browser in list view (using the View as List command), a series of customizable columns appears to the right. Many of these columns contain data that's intrinsic to each clip, such as frame size, duration, tracks, and compressor; however, there are many more columns of information that you can populate yourself, including, but not limited to:

- Log note
- Label and Label 2
- Good
- Master Comment 1–4
- Comment A and B
- Description
- Scene
- Shot/Take

You can enter text in these columns either directly within the Browser or using the Item Properties window. Once populated, these columns can be used to sort items in the Browser in either ascending or descending order. You can even create multiple-column sorts.

### **Add markers and notes to your clips to identify key sections**

You can prepare your media for editing by playing through clips you've ingested and placing markers to identify key sections that you may want to use in the future. Each marker you place can have a name and comment attached to it, which will appear in the Viewer whenever the playhead is positioned over the marker. You can use the Name and Comment fields to identify cut points between shots and takes, call attention to key moments of action, or even create a partial transcription of important dialogue by placing markers at the beginning of each annotated line. Markers can be further identified using colors, to help you distinguish between markers that have different purposes.

Once placed within a shot, these markers can be used for navigation in the Viewer or Timeline. You can also access a menu of every marker within a clip by opening the clip in the Viewer and Control-clicking the Current Timecode field. Choosing a marker from the resulting shortcut menu instantly moves the playhead to that marker.

Markers can also be viewed within the Browser (in list view) by opening the disclosure triangle to the left of any clip that contains markers. All markers for that clip are revealed in a list below the clip. Opening a marker in the Viewer opens a partial section of that clip with a duration defined by the space between that marker and the next.

### **Use subclips to break longer clips into more manageable pieces**

You can break long clips into smaller ones using the Make Subclip command in Final Cut Pro. This is especially useful when you're capturing extremely long clips from tape that comprise many different shots all running together. It's also useful when ingesting tapeless media in which many takes were recorded as one continuous shot. You can define individual subclips one by one with the placement of In and Out points, or you can define many subclips all at once using markers.

*Tip:* If you've already added markers to identify multiple shots in a clip, you can select all the markers in the Timeline and use the Create Subclips command to create subclips for all the markers at once.

## **Organizing and Sharing Assets Using Final Cut Server**

You can use Final Cut Server to help manage the assets of larger projects. Final Cut Server includes features for project versioning, checkin, and checkout. It also offers advanced tools for asset organization, metadata management, and media conversion—all of which are especially useful in multiple-suite post-production facilities where multiple editors, compositing artists, colorists, and sound designers need to access the same collection of assets.

This scenario is most effective if your facility is set up with a storage area network (SAN), such as a Fibre Channel network, that provides fast performance. Although it's not required, you can manage storage area networks using Apple's Xsan software, to distribute access to a shared RAID storage volume among multiple workstations.

For more information, see the Final Cut Server and Xsan documentation.

## **When Is Cinema Tools Involved with Media Organization?**

Cinema Tools is an essential organizational tool whenever you're ingesting film that was telecined to video. Valuable notes from the set and other organizational information may be included in the telecine log file that accompanies the transferred material, and Final Cut Pro (in combination with Cinema Tools) lets you use that data to create a database that tracks the correspondence between the edge code of the source negative and the timecode of the transferred video, along with whatever additional data was added during the transfer.

When you import a telecine log file into Final Cut Pro, all of this information appears in the Browser, associated with each offline clip, ready for use as soon as you capture the media. There are additional columns in the Final Cut Pro Browser that are dedicated to film information coming from Cinema Tools. These columns include:

- Aux timecode tracks and reel numbers
- Film Slate
- Camera Roll
- Lab Roll
- Film Standard
- TK Speed
- Key Number
- Ink Number
- Daily Roll
- Take Note
- Shot Note
- Scene Note
- Sound TC
- Sound Roll

For more information, see the Cinema Tools and Final Cut Pro documentation.

*Tip:* When you have your camera negative transferred to video, you can request that notes from the set that were gathered by the script supervisor be entered in the telecine log file, which can then be imported directly into Final Cut Pro (or imported indirectly using Cinema Tools), ready for use by the editor.



This chapter covers the following:

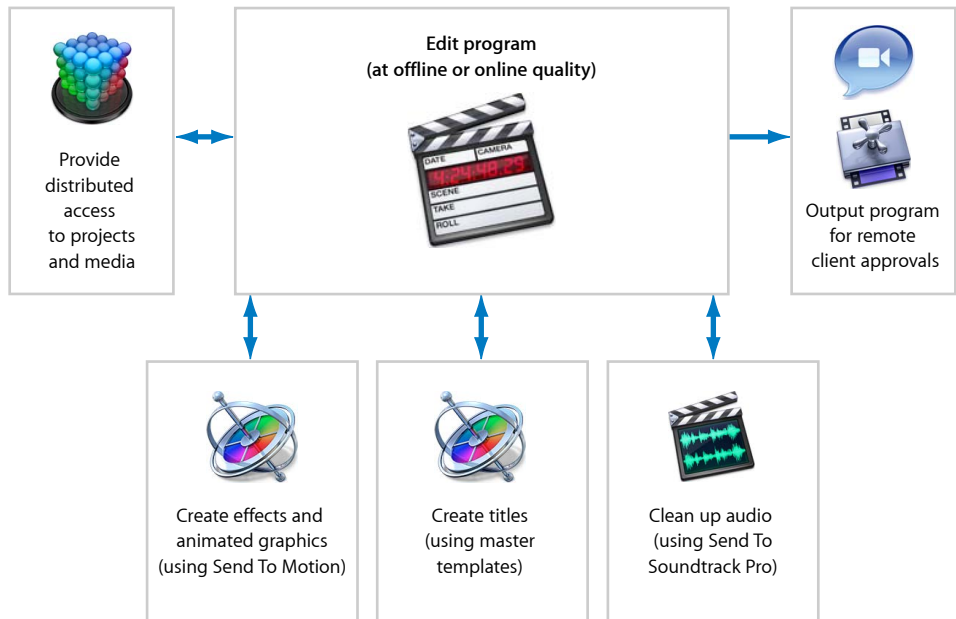
- What Is Editorial Development? (p. 49)
- Importing Editorial Information from Other Sources (p. 50)
- Integrating Titles and Broadcast Design Elements During Editing (p. 52)
- Audio Cleanup and Sound Design During the Offline Edit (p. 57)

This chapter describes different ways in which Final Cut Studio applications can be used together during the editorial development phase of post-production. For more information about the editorial workflow itself, see the Final Cut Pro documentation.

## What Is Editorial Development?

Sometimes called the *offline* or *story* edit, this is the stage when a program's creative content is explored, shaped, and eventually refined to the point where the cut can be locked in preparation for finishing. This process is referred to as an "offline" edit because, for disk space and performance reasons, media is often ingested at a significantly lower quality than the final master will be finished at. Although many editors still follow this workflow (especially for formats at high resolutions such as 2K and 4K that are processor-intensive and require a lot of disk space), it's becoming increasingly common for programs to be ingested and edited at the final level of quality from the very start. For more information about ingest strategies and how they vary depending on the quality of media you're working with, see "Ingesting and Organizing Your Media."

Although cutting picture and sound are the heart of this process, editorial development also includes the development of titles and graphics as well as broadcast design animation. Editorial development can also include a certain amount of audio cleanup and sound design, temporary music placement and editing, and even temporary color correction. All of these elements, whether in a rough or final state, play a part in helping you to hone the final content. There are numerous ways of using Motion and Soundtrack Pro together with Final Cut Pro to accomplish all of these additional tasks, integrating the output from each application inside Final Cut Pro in a way that keeps your workflow fluid.



**Note:** Frequent client reviews are another critical part of the editorial development phase. This topic is covered in detail in “Client Review.”

## Importing Editorial Information from Other Sources

As a Final Cut Studio user, you will do most, if not all, of your editing in Final Cut Pro. However, if you’re inheriting a project that was started in another editing environment, there are a variety of options for importing it.

### **Import an Edit Decision List from another application**

The Edit Decision List (EDL) format is one of the oldest and most widely supported project interchange formats for editing. EDLs are formatted as plain text documents, which can be output and read by most editing applications. Because they've been around for so long, they describe only the most basic components of an edited project, namely audio and video edits, basic transitions (from a list of SMPTE standard transitions), and superimpositions (called *key edits*). EDLs date from a time when all video came from tape. Each edit in a sequence is called an *event* and is represented by a separate line in the EDL that contains the reel number and timecode information necessary to relate each video clip to the source tape it came from. Additionally, EDLs generated by nonlinear editing applications like Final Cut Pro usually include the name of the clip as an optional comment.

Despite their age, EDLs are still widely used for moving basic projects between applications, and either recapturing the source media from tape or converting the media using a third-party utility for relinking.

Additionally, EDLs are often used after the offline edit has been locked to reconform a project on another system for color correction and finishing. In Final Cut Studio, EDLs are used to conform an offline edit to the originally scanned DPX or Cineon image sequences in Color when following a digital intermediate workflow.

### **Import XML projects**

The Final Cut Pro XML Interchange Format was designed to describe every element in a Final Cut Pro project in an XML-based format. Because XML is an easily decipherable format for programmers, the Final Cut Pro XML Interchange Format facilitates the processing of Final Cut Pro projects using external utilities (if you're ambitious, you can develop your own methods for editing and processing XML projects using text editing tools) and enables more sophisticated project interchange with third-party applications. Final Cut Pro can import and export this format, and there are an increasing number of third-party utilities for processing and exchanging XML project files in different ways.

XML is also used extensively among Final Cut Studio applications to move project data around. For example, when you send a Final Cut Pro sequence to Color, XML is used to translate the project data from one application to the other.

### **Import projects using third-party utilities**

There are dedicated third-party utilities designed to facilitate project interchange, such as software from Automatic Duck. Also, many third-party editing and color correction applications are developing the means to import Final Cut Pro XML Interchange Format files to better facilitate project exchange.

## Integrating Titles and Broadcast Design Elements During Editing

Most editors begin integrating titles and broadcast design elements into their projects during the offline edit. In some cases these clips are temporary placeholders, and in other cases the final titles are created right away. If your program requires animated design elements or effects, Final Cut Studio provides two environments in which these can be created.

- You can use Final Cut Pro to create titles, effects, and animation using generators, filters, composite modes, and Motion tab settings, all without leaving your editing environment. For more information, see the Final Cut Pro documentation.
- Motion has all of those features and more—including advanced text design tools, 3D compositing, particle systems, motion tracking, paint, and masks—and is easily integrated with other Final Cut Studio applications.

If your needs are more specialized than either of these applications can accommodate, you can also create graphics and animation in third-party applications and export them into one of a number of compatible formats for import into your project. For more information, see:

- *“Using Design Elements from Motion”*
- *“Using Graphics and Animation Files from Other Applications”*

### Using Design Elements from Motion

Although Final Cut Pro has many built-in compositing and animation features, Motion offers many more tools and capabilities for creating sophisticated broadcast design graphics and animation. The Motion application’s behavior-driven animation, Curve Editor for complicated keyframe editing, advanced text design tools, particle systems, replicator, 2D and 3D compositing tool set, and other features are ideal for the experimentation and refinement that creative design requires.

Final Cut Pro and Motion are closely integrated, making it easy to incorporate titles and design at any stage of your editorial process. For more information, see the Final Cut Pro and Motion documentation.

## Editing Media from Motion into a Final Cut Pro Sequence

If you've already created a Motion project that you want to use in your Final Cut Pro sequence, there are two ways you can edit it into your sequence.

- *Edit a Motion project file into a Final Cut Pro sequence:* You can import any Motion project file into a Final Cut Pro project. Motion projects (with the file extension .motn) appear just like any other clip in the Browser and can be opened in the Viewer, have In and Out points set, and be edited into a sequence just the same as any other piece of media. This option is an excellent way to handle Motion content that may be subject to revision, because it's easy to modify it as often as necessary. Simply select the Motion clip you need to revise and use the Open in Editor command to open it in Motion, where you can make whatever changes you like, save, and then reopen the Final Cut Pro project to see the updated result. Keep in mind that Motion clips are processor-intensive to play in Final Cut Pro, and the RT pop-up menu needs to be set to Unlimited RT to play them at all.
- *Export a QuickTime file from Motion to edit into your sequence:* You can also export a QuickTime file (with the file extension .mov) from Motion for editing into your Final Cut Pro sequence. This is a more efficient solution for real-time playback in Final Cut Pro, but it makes revisions a bit more involved, because changes require reopening the original Motion project and reexporting a new version of the clip. You can export clips from Motion using any QuickTime codec (high-quality codecs are best to maximize the quality of your compositions), but if you need to preserve regions of transparency in your composition, you need to use either the Animation (8-bit) or Apple ProRes 4444 (10-bit, the default choice) codec.

## Using Send To Motion Project

If you have one or more clips that you want to incorporate into a Motion composition, you can use the Send To Motion Project command. There are three ways you can send media to Motion from Final Cut Pro.

- *Send one or more clips from the Browser:* You can select one or more clips in the Browser and use the Send To Motion Project command. A new Motion project is created with an empty Timeline, and the selected clips from Final Cut Pro are placed in the project's Motion Media tab. This strategy is useful when you simply want to send a group of unedited clips that you'll assemble into a composition within Motion.
- *Send one or more clips from within a sequence:* If you select one or more clips in an edited sequence and use the Send To Motion Project command, a new Motion project is created with those clips already placed in the Timeline. Each clip's In point, Out point, and position relative to the others match those of the original Final Cut Pro sequence. (The selected clips can be either contiguous or noncontiguous.) Each clip appears on its own layer along with any clip and sequence markers, and all Motion tab settings, linear and Bezier keyframes, composite modes, and SmoothCam filters are translated into their Motion equivalents. This is useful when you want to use a partial section of a Final Cut Pro sequence as the starting point for a Motion composition.

When you send one or more clips from within a sequence, you have the option (turned on by default) of immediately embedding a Motion clip in your sequence to replace the media being sent. This way, once you finish working in Motion, all you need to do is save the project and return to Final Cut Pro to see the results already there in your sequence. For safety, the original clips are also nested into a separate sequence bearing the name of the Motion project you created, so you can easily go back to the original clips, if necessary.

- *Send an entire sequence:* You can also select an entire sequence in the Browser and use the Send To Motion Project command. This is similar to sending one or more selected clips from within a sequence, except that every single clip from the sequence is sent to Motion, each on its own layer, along with all compatible attributes. This is useful when you want to move an entire edited sequence of clips into Motion to use as the foundation for an effects-intensive treatment.

### Using Master Templates in Final Cut Pro

You can create a template in Motion to use as a generator from within Final Cut Pro. Your templates can be designed using whichever media and Motion features you like and can contain text and media drop zones that you define, which can be edited from within Final Cut Pro. Master templates are especially useful for title packages and lower thirds that will be edited into your sequence repeatedly but that may be subject to change. You can edit as many instances of a master template into your Final Cut Pro sequence as you like, customizing each as necessary. When you need to make a change to the look of these titles, you need only modify the template in Motion and save your change, and the change is applied automatically to every instance of that template in your sequence.

For more information about creating and using templates in Motion to use in Final Cut Pro, see the Motion documentation.

### Using Graphics and Animation Files from Other Applications

If, for whatever reason, you need to use third-party applications to create either still-image or animated media, you can easily import files from applications like Adobe Photoshop, Adobe After Effects, Autodesk Maya, and Cinema 4D into either Final Cut Pro or Motion.

If you need to make a change to an image or animation file that you've already imported, the Open in Editor command opens any file using the application specified by that file's creator code. You can also choose the specific application with which to open still-image, video, and audio files in the External Editors tab of the System Settings window. See the Final Cut Pro documentation for more information.

**Note:** Whenever you make an alteration to a still-image file, you need to save it in the application you're editing it in before returning to Final Cut Pro, so your sequence is updated to reflect the change.

## Compatible Still-Image Formats

All Final Cut Studio applications that can import graphics files are capable of supporting a wide variety of image formats. However, because of their high quality and prevalence, the following formats are the ones most commonly used for post-production media interchange. (All these formats support alpha channels for preserving transparency.)

- *TIFF*: The Tagged Image File Format is a commonly used image format for RGB graphics on a variety of platforms.
- *PICT*: A common image format used on Mac computers, PICT files can use any of the standard QuickTime codecs for compression in color or grayscale.
- *TARGA (TGA)*: An uncompressed file format that's been in use for many years.
- *JPEG*: A highly compressed image format created by the Joint Photographic Experts Group. The amount of compression that may be applied is variable, but higher compression ratios can create visual artifacts, visible as discernible blocks of similar color. With minimal compression, this format can be suitable for an online workflow.
- *PSD*: Both Final Cut Pro and Motion support the import of layered Photoshop files, either with layers preserved or with layers collapsed into a single item.

## Image Sequences

Some workflows use image sequences to move animation from application to application. An image sequence is a collection of individual image files in which each file is a frame of a movie or animation clip. The filenames contain the frame number, which is used to organize the sequence for playback. Image sequences are used frequently in digital intermediate workflows and are also used for rendering computer animation and high-end compositing. The various applications in Final Cut Studio handle image sequences differently.

- *Image sequences in Final Cut Pro*: Final Cut Pro can export image sequences (using the Export Using QuickTime Conversion command) but *cannot* import image sequences for use as media clips. If you have one or more image sequences you need to use in Final Cut Pro, it's best to convert them to QuickTime files using Compressor or Color first.
- *Image sequences in Motion*: Motion can both import and export image sequences. You can specify that imported image sequences be treated as a single clip by clicking the "Show image sequences as collapsed" button in the File Browser.
- *Image sequence conversion in Compressor and Color*: Compressor and Color are both capable of importing image sequences, for purposes of converting them to other formats of QuickTime for ease of organization and use. To preserve maximum quality, convert image sequences to QuickTime movies using the Apple ProRes 4444 codec. Compressor and Color are also capable of converting QuickTime media to image sequences. For more information, see the Compressor and Color documentation.

## Compatible Media Formats for Animation and Effects

The format you choose depends on whether or not you need to preserve regions of transparency in the media file. For example, if you're creating a lower third graphic, you need to preserve the transparent background so that you can superimpose the actual title graphic over the video image in your edited sequence. On the other hand, if you're creating a graphic or effect that's designed to fill the entire screen, preserving the alpha channel isn't important, and you can choose from a wider variety of codecs. (However, it's still smart to pick the highest-quality codec that's compatible with your workflow to preserve the maximum image quality in your graphics.)

- *Codecs that support alpha channels:* Apple ProRes 4444 (a newer, lightly compressed, 10-bit, variable bit rate codec) and Animation (an older, lossless, compressed, 8-bit codec) are both RGB, 4:4:4 codecs that are capable of preserving alpha channel data that's written to the file.
- *High-quality codecs with no alpha channel support:* Apple ProRes 422 (a 10-bit, variable bit rate, compressed codec suitable for standard definition mastering), Apple ProRes 422 (HQ) (a 10-bit, variable bit rate, compressed codec suitable for high definition mastering), and 8- and 10-bit Uncompressed (suitable for either standard or high definition) are all Y'C<sub>B</sub>C<sub>R</sub>, 4:2:2 codecs that are suitable for media exchange between applications.

If the application in which you're creating your media cannot write to these QuickTime formats directly, you can probably use one of the available third-party QuickTime components or utilities, in conjunction with Compressor or another media-processing application, to convert the exported media as necessary for use with Final Cut Studio.

## Tips for Designing Graphics in Third-Party Applications

When you design still images or motion graphics clips to use in a film or video project, you need to consider the sequence into which they'll be edited.

- *Resolution and pixel aspect ratio:* If you're creating a motion graphics or animation clip, the resolution (width by height, in pixels) and pixel aspect ratio (square versus non-square) should match those of the destination sequence to maximize real-time performance once the clip is edited into the program. If you're importing graphics, this is not strictly necessary. In fact, graphics are often brought in at a larger size than the sequence size in order to create animated pan and scan effects using the Final Cut Pro Motion tab settings.
- *Action and title safe:* For both still images and motion graphics clips, keep in mind the action and title safe guidelines to prevent important text or images from being cut off around the edges of the frame. Many image editing and animation applications provide overlays to indicate the outer portions of the frame you should avoid. If you're working on graphics for a film, inquire what the recommended aperture is for the film format being printed to.



- *Broadcast safe luma and chroma levels:* Even if you'll color correct your images later, it's useful to keep the maximum broadcast safe levels for color and brightness in mind when your titles and graphics are being designed. In particular, text should never use 100 percent white, as the high-contrast edges around pure white text can cause unwanted spikes in the signal. All text should be limited to 95 percent white or lower. (Don't worry, this is plenty bright for white on a television.) It's also common for regions of the picture where highly saturated elements intersect with objects that are very bright to cause problems with broadcast legality. Many third-party graphics editing and compositing applications have "broadcast safe" filters that can be used to legalize your compositions in advance so there are no surprises, but you can do the same thing by being mindful when choosing the color palette of your graphic.

For more information about designing graphics for broadcast, see the Final Cut Pro documentation.

## Audio Cleanup and Sound Design During the Offline Edit

Final Cut Pro includes professional features for adjusting, mixing, and filtering audio. However, there are times when it may be faster or easier to make corrections to problematic audio clips with other tools.

Additionally, it can sometimes be difficult to work creatively on the visuals of a project if the audio is incomplete, especially if there's no music. You can use both Soundtrack Pro and GarageBand to create temporary tracks that you can use to time your edited projects prior to importing the actual music files. For more information, see the following sections:

- "Sending Specific Clips to Soundtrack Pro for Cleanup"
- "Processing Audio Using an External Editor"
- "Creating Temporary Music in Soundtrack Pro, GarageBand, or Logic Studio"

### Sending Specific Clips to Soundtrack Pro for Cleanup

If you discover clips with problematic audio during the editing process, you have the option of sending individual audio items to Soundtrack Pro for audio sweetening. Soundtrack Pro has numerous tools and effects for quickly taking care of problems:

- Noise-reduction tools, to deemphasize unwanted background noise
- Ambient noise addition tools, to fill holes in audio clips with sampled background ambience (room tone) to cover up lift edits
- Equalization-matching tools, to automatically add EQ to one or more clips to match the sonic properties of audio recorded at another location
- DeEsser effect, for controlling overly sibilant audio
- Advanced compression and expansion tools, for controlling a clip's dynamics

The two ways of sending individual clips or groups of clips to Soundtrack Pro are summarized below. For more information, see the Soundtrack Pro documentation. All of these operations can be applied nondestructively, so if you're unsatisfied with your results later, you can easily change your adjustments or remove them entirely.

- *Send To Soundtrack Pro Audio File Project:* You can select one or more audio clips in Final Cut Pro and use the Send To Soundtrack Pro Audio File Project command to create a series of separate Soundtrack Pro audio projects, one for each item that was selected. When you send audio to Soundtrack Pro, you have the option of sending all source media for each selected item, or sending only the portion of audio that appears in the sequence, with handles. The original audio items are automatically connected to the Soundtrack Pro audio files, and any changes you make in Soundtrack Pro appear in your Final Cut Pro sequence.

For example, after inserting a new clip into an edited documentary sequence, you may discover that its audio has an annoying air conditioner hum that doesn't match the audio of the other clips in the sequence. You can select the audio from that clip, send it to Soundtrack Pro, and use the noise-reduction tools to minimize the hum. After saving your fix and returning to Final Cut Pro, the audio item is automatically updated with the fixed audio, and you can continue working.

Incidentally, converting individual audio clips to Soundtrack Pro audio files doesn't prevent you from later sending all of your sequence's audio to Soundtrack Pro as a multitrack project when the time comes to do your final mix, as described in "Final Sound Editing, Design, and Mixing." In fact, all the operations applied to individual files reappear in the multitrack Soundtrack Pro project that's created later, and you'll still have the ability to modify or turn off earlier corrections if you need to.

For more information, search for "sending clips to Soundtrack Pro" in Final Cut Pro Help.

- *Send To Soundtrack Pro Script:* You can also save a series of actions in the File Editor project view as an AppleScript droplet, which can be used from within Final Cut Pro using the Send To Soundtrack Pro Script submenu. All Soundtrack Pro scripts that are saved in the default location (`/Users/username/Library/Scripts/Soundtrack Pro Scripts/`) appear in this submenu.

For example, if you have a series of voiceover clips that were all recorded during the same session, and you apply a particular set of de-essing, compression, and equalization operations to improve the voiceover recording, you can use the Save as AppleScript command from within Soundtrack Pro to turn your operations into a script, which will become available from within Final Cut Pro. Going back to your sequence, you can select the other voiceover clips and then choose your script from the Send To Soundtrack Pro Script submenu to process them in the same way.

For more information, search for "scripting actions" in Soundtrack Pro Help.

## Processing Audio Using an External Editor

If you need to make a change to an audio item that you've already imported, you can use the Open in Editor command to open any file using the application specified by that file's creator code. You can also choose the specific application with which to open audio files in the External Editors tab of the System Settings window. See the Final Cut Pro documentation for more information.

## Creating Temporary Music in Soundtrack Pro, GarageBand, or Logic Studio

Because editing typically begins long before a composer starts working on the score, editors often rely on temporary ("temp") music to develop the rhythm of a scene and to make it easier to watch events in an emotional context. Many editors use stock music or music files provided by the director or producer as a reference until the final soundtrack is available. However, if you're musically inclined, you also have the option of using a music application (two of which you probably already have installed) to create custom temp music that's specific to your needs.

### Using Soundtrack Pro

Soundtrack Pro comes with a library of loops of different musical styles that you can use to assemble a quick multitrack music bed that's specific to the mood of your scene. Although the Soundtrack Pro interface has been refined over the years to support dialogue cutting and mixing for audio post-production, its roots as a loop-based music editor, along with its audio library search tools, make it well suited for the creation of temp music tracks. You can expand your library of loops for even more variety by buying add-on loop collections from Apple (Jam Packs) and from many third-party vendors.

If you want to work synchronized to picture, you can select the range of clips you want to create music for and then use the Send To Soundtrack Pro Multitrack Project command to send the selected video and audio to Soundtrack Pro together. If you placed scoring markers in the Timeline, these are sent to Soundtrack Pro also. After assembling the loops you want to use as your temp music bed, you can disable the source audio tracks and export the temp tracks as a single AIFF or WAVE file for editing back into your original sequence.

### Using GarageBand

GarageBand (which you probably already have on your computer) also comes with a library of loops that are actually shared with Soundtrack Pro, so that all the loops available to one application are also available to the other. GarageBand has a streamlined interface dedicated to music creation using loop editing, MIDI instruments, and live recording.

You can also work synchronized to picture in GarageBand, but you need to export the scene you want to use as a QuickTime movie first. Dragging a QuickTime movie into a GarageBand project window adds the audio and video to the project so you can arrange your loops in time to the picture. When you finish, you can use the Hide Movie Track command to disable the video, and then you can use the Export Song to Disk command to export an audio file that you can edit back into your original Final Cut Pro sequence. (Make sure to turn off Compress in the dialog that appears when you choose the Export Song to Disk command.)

### Using Logic Studio

Logic Studio (which also includes Soundtrack Pro) is a suite of applications from Apple dedicated to high-end music production. Although Logic Studio is an extremely powerful music production tool and may be more than you need for the purpose of simple temp track creation, it's noteworthy because of its enormous library of loops, all of which are compatible with Soundtrack Pro and GarageBand.

**Note:** Logic Pro also has the ability to send audio to Soundtrack Pro, which is described in “Make Sure You Have the Right Setup for Mixing.”

### Using a Third-Party Audio Application

There are a wide variety of loop- and algorithm-based music creation tools for video. In general, most of these tools can export either AIFF or WAVE files that you can import into Final Cut Pro for use in your edited sequence.

This chapter covers the following:

- Arranging for Client Review (p. 61)
- Local Review Methods (p. 62)
- Remote Review Methods (p. 63)

Final Cut Studio provides several ways of delivering your program for review during any part of the organization, editing, or finishing process. This chapter summarizes the different options that are available to you.

## Arranging for Client Review

Throughout the post-production process, it's critical to get ongoing feedback about the program you're working on. Whether you're getting your feedback from friends and family, clients, or test audiences, it's important to be able to provide a screening copy (or "screener") of your program in a format that's convenient for viewing.

Once upon a time, videocassettes were the most common way of providing a copy of your program. With the demise of consumer tape formats, tape output (to more expensive formats) is now ordinarily reserved for the final master. Instead, it's common to provide your program as a QuickTime movie, DVD, or Blu-ray disc. The appropriate format for your purpose depends on the level of quality necessary for a useful review and the preference of the reviewer.

## Providing a Window Burn for Reference

When providing a review copy to your client, it can be extremely useful to add a timecode window burn to the video. A timecode window burn superimposes the program's run time over the visuals of the program, in order to provide a consistent timing reference that your client can use to identify the exact moment referred to in each note he or she gives you. You can add a timecode window burn to your program in several ways:

- You can add a window burn to your program within Final Cut Pro, using the Timecode Generator or Timecode Reader filter.
- You can add a window burn to a Motion project using the Timecode generator.
- You can add a window burn to media you create with Compressor, using the Timecode Generator filter.
- If you're having a review session using iChat Theater Preview, you can turn on a timecode reference that the remote viewer can see.

For more information, see the Final Cut Pro and Compressor documentation.

## Local Review Methods

It sounds obvious, but if you need the maximum communication while you work, with minimum preparation and the highest-quality playback, there's no substitute for having your client in the room with you.

### Review locally for quality control

It's especially important to have the client with you if you're performing finishing tasks such as color correction or audio mixing where quality control is essential. During the finishing process, it's critical for your client to be looking at the same monitor and listening to the same speakers, *in the same environment*, that you are. Otherwise, you risk getting feedback that has more to do with the quality and calibration of the client's remote equipment than it does with your actual adjustments.

Even if you're routinely delivering copies of your program to a client for remote viewing, it's a good idea to arrange for at least one face-to-face review session of the entire program at your suite, to make sure that all video and audio adjustments are definitively approved.

### Review via Final Cut Server

If you're in a facility that uses Final Cut Server to manage the various assets of your program, you can use the Review and Approve feature of Final Cut Server to notify reviewers of the availability of a program on the server. You can then track the status of the review as the program is checked out and in from different suites of a multiple-room facility. Final Cut Server is also capable of keeping a record of all editorial feedback from every invited viewer. For more information, see the Final Cut Server documentation.

## Remote Review Methods

Final Cut Studio provides many ways of delivering clips and edited sequences to remote reviewers. The methods that are appropriate for your project depend on the formats preferred by your client and the level of quality required to get useful feedback.

For example, if you're getting feedback on how the editing of a program is working, color accuracy and high resolution may not be important, so web delivery is a convenient option. However, if you're getting feedback on how a program looks and sounds, it may be better to deliver a higher-quality review format such as a DVD or Blu-ray disc.

### Use the Share command

The Share command in Final Cut Pro and Motion provides a fast and convenient way to output your program for remote review in a variety of formats, without the need to use any other applications. The Share command can output either a single clip or a sequence, or you can create a single output from a group of selected clips and sequences, which can be useful for reviewing dailies.

- If you require a “living room” preview using a disc-based consumer format, the Blu-ray and DVD options let you quickly encode and output discs in either format in one step. This is a great way to see how your program looks and sounds in a typical consumer viewing environment. It's also an excellent way of creating media that's suitable for audience test screenings in venues that lack videotape playback.
- If you or your client has fast Internet access and a MobileMe or FTP account for remote uploading and downloading of media, it may be preferable to use one of the highly compressed QuickTime-based options for delivery, such as Apple TV, iPhone, iPod, or QuickTime H.264. If you need to further customize the compression settings being used (for example, if you want to add a timecode window burn using Compressor), you can click the Send to Compressor button to open a Share preset in Compressor. Although QuickTime playback is convenient for reviewing editorial decisions, remember that computer displays have a completely different color space than consumer television monitors, making it difficult to evaluate picture quality in a meaningful way.
- There are also options for automatic encoding and uploading to MobileMe and YouTube for video hosting (you must have a MobileMe or YouTube account).
- If your client requests high-resolution QuickTime files, there is an Apple ProRes 422 option (which yields excellent quality for SD programs and good offline quality for HD programs) as well as an Apple ProRes with Alpha option (which uses Apple ProRes 4444, a high-bandwidth codec for high-quality HD, 2K, and 4K RGB-encoded programs).

For a list of all available Share options and more information about using them, see the Final Cut Pro and Motion documentation.

### **Create a DVD with DVD Studio Pro**

If you want to hand off a copy of the program for someone to review from the comfort of home, you can use DVD Studio Pro to author a standard definition DVD with more options than the Share command's DVD preset provides. Although this process is a bit more involved, you can add surround-encoded audio tracks, chapter menus, multiple movies encoded to the same disc, and other features that might be better suited to your review process. For more information, see the DVD Studio Pro documentation.

### **Use iChat Theater Preview**

You can use the Final Cut Pro iChat Theater Preview feature to instantly screen parts of your work for remote viewers who are also using iChat. To facilitate iChat Theater Preview playback, the Final Cut Pro video is streamed at a lower, optimized frame rate for live transmission over the Internet and is formatted to fit the iChat window. All Canvas or Viewer overlays and warnings or messages, such as messages about dropped frames during playback, are turned off.

Although you host a video chat session using iChat Theater Preview, you can play clips or sequences in either the Canvas or the Viewer, and Canvas or Viewer playback is mirrored for the remote viewer. You can also open multiple Viewer windows and switch among them to show different clips. The frame displayed in the Viewer or Canvas appears in the remote viewer's iChat window. In Final Cut Pro, you can stop playback and reposition the playhead on specific frames to discuss them. You can also have Final Cut Pro display the timecode of the current frame in the remote iChat window to help the remote viewer identify specific frames, and you can control the playback volume using the Audio Mixer.

iChat Theater Preview requires that both the host's and remote viewer's computers have Mac OS X v10.5 Leopard or later as well as a fast Internet connection. Both users must have iChat accounts, and the remote viewer's account must be added to the host user's buddy list. The remote viewer's video playback performance is affected by the speed of the network connection, the processing speed and power of the host and client computers, and the processing power required to play the particular format of video being used.

For more information about configuring and using iChat Theater Preview, see the Final Cut Pro documentation.



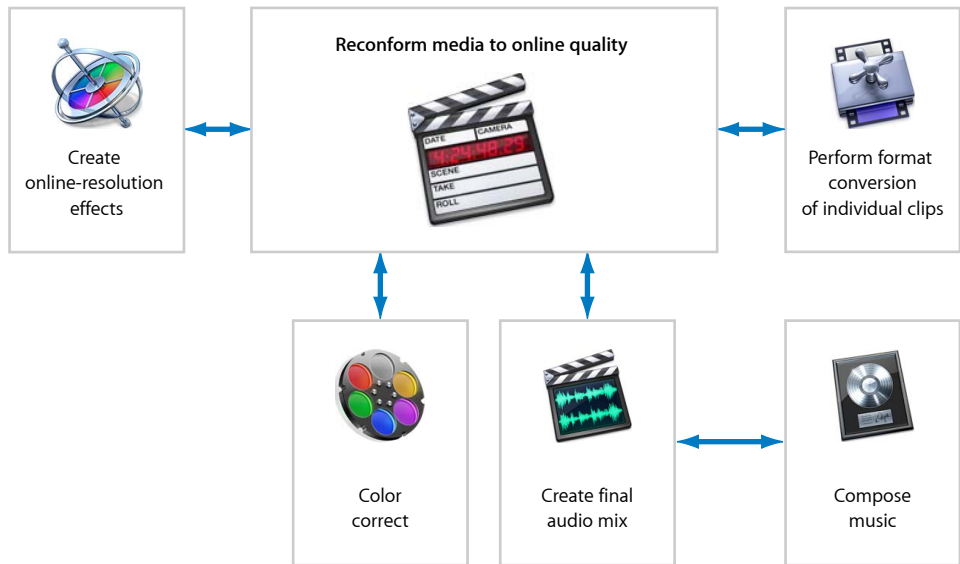
This chapter covers the following:

- What Is Finishing? (p. 66)
- Finishing Using Compressed Versus Uncompressed Media (p. 67)
- Format Conversion When Finishing Mixed-Format Sequences (p. 69)
- Reconforming Media to Online Quality (p. 71)
- Creating Final Broadcast Design Elements and Effects (p. 79)
- Color Correction (p. 82)
- Final Sound Editing, Design, and Mixing (p. 90)

This chapter describes how Final Cut Pro, Compressor, Color, and Soundtrack Pro work together to let you apply the final polish to your programs.

## What Is Finishing?

*Finishing* is a catch-all phrase that describes an entire family of related activities. In a nutshell, finishing describes the process of giving your edited program the final polish it needs to make it as seamless and professional as possible prior to mastering and output.



The essential finishing tasks include:

- *Reconforming*: If your program's offline edit was accomplished using lower-quality media than was originally shot, reconforming is the necessary step of replacing all your offline media with high-quality online media.
- *Creating final effects*: This is also the time to complete all necessary effects work, prior to the next task.
- *Color correcting*: The color and contrast of every shot in your program need to be adjusted to make the visuals look as good as they possibly can.
- *Sound design and mixing*: This step often happens at the same time as color correction. Additional sound effects, ambience, and music are added to your program, and the levels, balance, and quality of every track are adjusted so they blend together into a harmonious whole.

The following topics provide more information about how to proceed with the finishing process:

- "Finishing Using Compressed Versus Uncompressed Media"
- "Format Conversion When Finishing Mixed-Format Sequences"
- "Reconforming Media to Online Quality"

- “Creating Final Broadcast Design Elements and Effects”
- “Color Correction”
- “Final Sound Editing, Design, and Mixing”

### Don't Feel Obligated to Do Everything Yourself

Many of the tasks involved with finishing are highly specialized activities. Final Cut Studio is used by a wide variety of post-production facilities, boutique shops, and individual professionals, which means you can easily take your project and media files to a specialist for reformatting, color correction, audio mixing, effects work, or any other task that you either don't have the equipment for or don't feel comfortable undertaking yourself.

However, if you do enjoy the challenge of learning new skills and tools, Final Cut Studio provides everything you need to finish and output your programs at high quality.

### Finishing Using Compressed Versus Uncompressed Media

When you are deciding how to ingest your media, a common question is how best to handle compressed formats if you know you want to finish at the highest possible quality later. One of the advantages of working with compressed formats such as DV-25, HDV, AVCHD, DVCPRO HD, or XDCAM is that you can ingest them natively, at their original resolution and quality, with relatively modest storage and processor requirements (at least with the current generation of Mac computers). However, when the time comes to finish your program, adding the final titles, design, and effects and doing color correction prior to mastering your program, questions sometimes arise about whether working with such highly compressed media is appropriate.

This section addresses why preemptive upconversion (transcoding a compressed media file to an uncompressed media file) before you start the finishing process may be unnecessary and when it might provide advantages. It also notes when, at the end of the finishing process, upconversion is a necessary step.

#### **Does upconverting compressed media from one codec to another improve quality?**

From a strictly qualitative standpoint, there is virtually no difference between a highly compressed media file and the same file transcoded—*at the same frame size and frame rate as the original media*—to a higher-quality codec (such as one of the Apple ProRes or Uncompressed codecs) using one of the Final Cut Studio applications. For the same reason, there's no qualitative advantage to simply transcoding to another codec during ingest.

Another possible approach is to upconvert *previously recorded* compressed media by connecting the SDI or HD-SDI output from a video deck or camcorder to the input of a video capture card, thus using the deck's circuitry to upconvert the compressed signal to an uncompressed media file during capture. However, this doesn't actually provide access to any additional pixels or samples of information. Depending on the hardware you're using, there will be some filtering and interpolation of the video signal's components, but this process simply alters the data that was originally recorded. It's debatable how much of a visible increase in apparent image quality is provided, and whether it's worth the additional hassle.

The bottom line is that simply transcoding media from one codec to another *in software* does nothing to improve image quality. Doing a *hardware* upconversion might or might not have a noticeable effect on certain kinds of compression artifacts, but in most instances it's probably easiest to keep your media in the format in which it was originally shot during the offline edit, preserving the data exactly as it was captured.

Keep in mind that once data has been discarded by compression in the camera *at the moment it's shot*, it is not retrievable, no matter what format you upconvert it to.

**Note:** Upconversion is not the same as *format conversion*, in which you change a clip's frame size, frame rate, and field handling in addition to the codec it uses. When doing format conversion, using specialized software (such as Compressor), third-party plug-ins, or dedicated hardware can result in a dramatic improvement in the final result. For more information about format conversion, see "Format Conversion When Finishing Mixed-Format Sequences."

### **Are there other advantages to upconverting compressed media?**

There are other legitimate reasons to transcode media from one codec to another. For example, you may find that working with some highly compressed formats natively is more processor-intensive than working with versions of the same media transcoded to one of the Apple ProRes codecs.

Another good reason to transcode is if the native resolution of the media is slightly different from the frame size at which you want to finish the program, and you don't want to deal with resizing issues. For example, many compressed high definition acquisition formats are anamorphic; DVCPRO HD may be recorded at 960 x 720, and HDV may be recorded at 1440 x 1080. If you prefer working at the nearest full-raster frame size in preparation for finishing, you may choose to upconvert your media to 1280 x 720 or 1920 x 1080.

Of course, that's not the whole story.

### **Why is it important to upconvert compressed media at the end of the finishing stage?**

When the time comes to color correct your program, near the end of the finishing stage, you'll be reprocessing and rendering every clip to which you either make adjustments or apply effects. Whether you're working in Final Cut Pro or in Color, all image processing is done in an internally uncompressed data space, regardless of the source format. Because you're adding filters and vignettes and performing other high-quality image-processing operations that will ultimately benefit from less compression, this is the appropriate time to render your compressed source media using an uncompressed or lightly compressed format suitable for mastering. This lets you retain the high quality of the image-processing operations being performed and prevents you from double-compressing your media unnecessarily. There are two ways of transcoding compressed media during rendering.

- *If you're grading your program in Color:* Make sure that your program's media is reconformed to its maximum native quality (or better) prior to sending it to Color, even if the native format is compressed. You can send either compressed or uncompressed media to Color, as long as the media is in a format that's compatible with Color. In Color, you specify the codec used to render the final color-corrected media using the QuickTime Export Codecs pop-up menu (in the Project Settings tab of the Setup room), and this is the point at which the internally uncompressed image data that's processed by Color is written to a superior media format suitable for mastering. See the Color documentation for more information.
- *If you're finishing your program entirely within Final Cut Pro:* The best solution for high-quality mastering is to change your sequence's codec using the Compressor pop-up menu in the General tab of the Sequence Settings window. It's also a good idea to open the Video Processing tab and make sure the bit depth is set to an appropriate quality for your program and that the Motion Filtering Quality pop-up menu is set to Best.

If you follow either of these workflows, it's not necessary to preemptively transcode your media in preparation for finishing, because it's simpler and easier to transcode your media during rendering, and you get the same results. For more information about rendering your final media using a mastering codec, see the Final Cut Pro and Color documentation.

### **Format Conversion When Finishing Mixed-Format Sequences**

Final Cut Pro supports mixed-format sequences, which is very convenient when you need to perform the offline edit of a project that incorporates a wide variety of source material. For example, it's common to mix high definition (HD) and standard definition (SD) clips in documentary programs. More extreme examples include programs that incorporate archival footage in different broadcast standards with different frame rates, such as programs that combine PAL and NTSC footage.

In some cases, you can mix formats and finish your program using the original media without problems. However, certain combinations of mismatched media attributes can cause trouble when the time comes to finish and output your project. This section illustrates how you should handle different combinations of clips in mixed-format sequences to avoid problems.

### **Which media attributes can safely differ from the sequence settings?**

The following clip characteristics can differ from those of the sequence without causing problems.

- *Codec*: You can freely mix clips using any codecs that are compatible with Final Cut Pro, as long as their frame rates, interlacing, and frame size are appropriate to the sequence. However, keep in mind that some broadcasters have specific requirements about what percentage of a program can use source footage in a highly compressed digital format such as HDV or AVCHD.
- *Aspect ratio*: Final Cut Pro lets you mix footage with different aspect ratios (for example, mixing footage with 3:4 and 16:9 aspect ratios), including anamorphic footage. Depending on the combination of sequence and media frame sizes, Final Cut Pro automatically *letterboxes* (places horizontal bars at the top and bottom of the screen) or *pillarboxes* (places vertical bars at the left and right of the screen) clips as necessary to fit them into the available width and height of the frame.
- *Bit depth*: You can mix clips with any bit depth Final Cut Pro supports. Typical bit depths for video include 8-bit and 10-bit.
- *Frame size*: If you set the Motion Filtering Quality pop-up menu (in the Video Processing tab of the Sequence Settings window) to Best, the scaling in Final Cut Pro is sufficient for modest enlargements and for shrinking higher-resolution clips down to smaller frame sizes. This means you're in good shape if you're editing HD clips into an SD sequence, as long as the frame rate and interlacing match all the other clips. However, if you're editing SD clips into an HD sequence, you may want to consider using Compressor to upscale your media for the best results, as described later in this section.

### **Which media attributes should not differ from the sequence settings?**

If you're preparing a sequence for finishing, the following clip characteristics should match those of the sequence to ensure seamless mastering and output.

- *Frame rate*: This is the most important clip characteristic that should match that of the sequence. Although you can freely mix frame rates during offline editing, it's not ideal to rely on Final Cut Pro to retime the frame rates of clips that don't match the sequence frame rate if you plan to output a high-quality master.
- *Interlacing*: Although you can freely mix progressive and interlaced clips during the offline edit, you typically need to output to one format or the other when you create a program's final master. Final Cut Pro is not the best environment for converting one field-handling standard to the other.

## What is the best way to do format conversion using Compressor?

If you have one or more clips in your sequence whose frame rates, scanning methods (interlaced or progressive), or frame sizes don't match, you can use Compressor to do a standards conversion of the mismatched clips. Compressor can use optical flow analysis to create high-quality conversions, but you have to choose the appropriate settings for your preset in the Inspector. With these settings chosen, processing times are high, but the results are worth it.

For more information, see the Compressor documentation. To briefly summarize, if you're doing standards conversion, turn on Frame Controls in the Frame Controls tab of the Inspector, and choose the following options.

- *Resize Filter pop-up menu*: For the highest-quality result when resizing smaller-resolution clips to a larger frame size, choose "Best (Statistical prediction)." You'll select the actual frame size to convert the clip to (along with cropping and pixel aspect ratio conversion options, if necessary) in the Geometry section of the Inspector.
- *Output Fields and Deinterlace pop-up menus*: If you need to deinterlace a clip or introduce interlacing to a clip, choose the standard you require from the Output Fields pop-up menu, and then choose "Best (Motion compensated)" from the Deinterlace pop-up menu. Additional options, including the Adaptive Details checkbox and the Anti-alias and Details Level sliders, let you adjust the way the final result is processed. If you're converting a telecined film clip with interlacing, choose Reverse Telecine instead to remove the 3:2 pull-down.
- *Rate Conversion pop-up menu*: If you're changing the frame rate, choose "Best (High quality motion compensated)," and then choose a conversion method from the "of source" pop-up menu, to the right of the "Set Duration to" field.

## Reconforming Media to Online Quality

If you're using an offline/online workflow to work on your program, you need to replace the offline-quality media you used while editing with high-quality online media in preparation for finishing, mastering, and output. This is known as *conforming* or *reconforming* your media.

How exactly you accomplish this depends on the kind of source media you started out with and the overall workflow you've been pursuing. Ideally, your final media should be at least equal to the quality of the media that was initially shot, recorded, or otherwise captured in the field. In practice, it's often acceptable to reconfirm to a high-quality compressed format that is visually indistinguishable from the source media, such as one of the Apple ProRes codecs. For overviews of the most common reconforming workflows, see:

- "Reconforming Offline Duplicates of Online Media"
- "Reconforming Tapeless Media"

- “Reconforming Tape-Based Media”
- “Reconforming via Telecine Retransfer”
- “Reconforming to DPX or Cineon Film Scans”

## Reconforming Offline Duplicates of Online Media

This workflow is appropriate for projects for which you originally ingested high-bandwidth media (such as 8- and 10-bit Uncompressed or Apple ProRes 4444 media) for eventual HD, 2K, or 4K mastering. It assumes that your offline edit was accomplished using offline-quality duplicates of the source media that were created with cloned timecode and reel numbers.

### Stage 1: Mounting the Volumes That Contain the Originally Archived Media

You need to mount the volumes you used to store the original online media, in preparation for a Reconnect operation. To relink the original media, Final Cut Pro needs access to every piece of media used in your sequence.

### Stage 2: Either Relinking the Media Right Away, or Creating a New Offline Sequence for Relinking

How you relink your project to the original online media depends on whether or not the frame size of your offline media matches that of the online media.

- *If the frame sizes of your offline and online media are the same:* Select all of the clips in your sequence whose media you need to relink (except for clips like generators, embedded Motion projects, or audio), and then Control-click one of the selected clips and choose Reconnect Media from the shortcut menu. Use the Reconnect Files dialog to reconnect all of your clips to the original source media.
- *If the frame sizes of your offline and online media are not the same:* Use the Media Manager to create an offline version of the final edited sequence, changing the sequence settings to match the resolution of your online media. Then Control-click the offline sequence and choose Reconnect Media from the shortcut menu. Use the Reconnect Files dialog to reconnect all of your media to the original source.

For more information, see the Final Cut Pro documentation.

## Reconforming Tapeless Media

This workflow is appropriate for projects using tapeless media formats (also called *file-based* formats), including DVCPRO HD and AVC-Intra (if recorded to P2 media), as well as native REDCODE media. The tapeless reconforming process takes place entirely within Final Cut Pro.

**Note:** Some tapeless formats, such as XDCAM, XDCAM HD, XDCAM EX, IMX, and REDCODE require third-party utilities and software for ingest into Final Cut Pro. For more information, see the *Professional Formats and Workflows* document, available in Final Cut Pro Help.



### Stage 1: Preparing Your Sequence for Media Management

In general, it's a good idea to do a certain amount of preparation to your sequence before using the Media Manager, in order to avoid retransferring media you don't really need. One easy thing you can do is to move all video clips that aren't being superimposed as part of an effect or compositing operation down to track V1. This process overwrites any hidden video items that appear underneath clips on higher video tracks (either partially or completely) that aren't really part of the edit. This process also nicely organizes the sequence for color correction later.

To make sure that all video items in the topmost video tracks correctly overwrite the hidden parts of clips in lower video tracks, move clip items down one track at a time; for example, move any noncomposited items in track V4 down to V3, then move all noncomposited items in track V3 down to V2, and finally move all of the noncomposited items in track V2 to V1.

### Stage 2: Using the Media Manager to Create an Offline Version of Your Edited Sequence

The safest way to reconfirm your project is to use the Media Manager to create an offline copy of your final sequence. Here are some recommended Media Manager settings. For more information, see the Final Cut Pro documentation.

- *Media pop-up menu*: Create offline
- *"Include render files" checkbox*: Off
- *"Set sequences to" pop-up menu*: Typically, you should choose the sequence setting that corresponds to the format of the media you'll be reingesting.
- *"Include master clips outside selection" checkbox*: Off
- *"Delete unused media from duplicated items" checkbox*: On
- *Use Handles checkbox*: This setting is optional, although having 1-second or 2-second handles is always a good idea to prepare for last-minute adjustments.
- *"Include affiliate clips outside selection" checkbox*: Off
- *"Base media file names on" pop-up menu*: Existing file names
- *"Duplicate selected items and place into a new project" checkbox*: This setting is also optional.
- *"Include nonactive multiclip angles" checkbox*: Off

### Stage 3: Mounting the Volumes That Contain Your Archived Tapeless Media

At this point, you need to mount whatever volumes you stored the archived tapeless media on, in preparation for ingest. Final Cut Pro needs access to every piece of media your sequence is linked to in order to successfully retransfer everything at once.

#### **Stage 4: Changing the Ingest Options in the Log and Transfer Window**

Open the Log and Transfer window and choose Preferences from the Action pop-up menu (the menu with the gear icon). When the Import Preferences dialog appears, choose the appropriate option from the pop-up menu in the “Transcode to” column corresponding to your format. When you finish, close the Log and Transfer window to save the new settings.

#### **Stage 5: Retransferring the Media Used in the Sequence**

When you’re ready to retransfer the footage, Control-click the new offline sequence that’s been created, then choose Batch Capture from the shortcut menu. When the Log and Transfer window appears, reingest all necessary footage from your archived media directories.

For more information, see the Final Cut Pro documentation.

### **Reconforming Tape-Based Media**

This workflow is intended for projects using SD and HD video recorded to tape. This workflow may also include film that was transferred to tape via a best-light or safety transfer. For this workflow to go smoothly, it is imperative that your timecode be reliable and that the reel number of each clip be accurate. Ideally, all of your clips should correspond to a clearly labeled set of tapes; this is especially important if you anticipate that another editor or facility may be doing the reconform.

#### **Stage 1: Preparing Your Sequence for Media Management**

In general, it’s a good idea to do a certain amount of preparation to your sequence before using the Media Manager, in order to avoid recapturing media you don’t really need. One easy thing you can do is to move all video clips that aren’t being superimposed as part of an effect or compositing operation down to track V1. This process overwrites any hidden video items that appear underneath clips on higher video tracks (either partially or completely) that aren’t really part of the edit. This process also nicely organizes the sequence for color correction later.

To make sure that all video items in the topmost video tracks correctly overwrite the hidden parts of clips in lower video tracks, move clip items down one track at a time; for example, move any noncomposited items in track V4 down to V3, then move all noncomposited items in track V3 down to V2, and finally move all of the noncomposited items in track V2 to V1.

#### **Stage 2: Using the Media Manager to Create an Offline Version of Your Edited Sequence**

The safest way to recapture the media needed by your program is to use the Media Manager to create an offline copy of your final sequence. Here are some recommended Media Manager settings. For more information, see the Final Cut Pro documentation.

- *Media pop-up menu:* Create Offline

- *“Include render files” checkbox*: Off
- *“Set sequences to” pop-up menu*: Typically, you should choose the sequence setting that corresponds to the format of the media you’ll be recapturing.
- *“Include master clips outside selection” checkbox*: Off
- *“Delete unused media from duplicated items” checkbox*: On
- *Use Handles checkbox*: This setting is optional, although having 1-second or 2-second handles is always a good idea to prepare for possible last-minute adjustments.
- *“Include affiliate clips outside selection” checkbox*: Off
- *“Base media file names on” pop-up menu*: Existing file names
- *“Duplicate selected items and place into a new project” checkbox*: This setting is also optional.
- *“Include nonactive multiclip angles” checkbox*: Off

### **Stage 3: Choosing Appropriate Capture Settings, Clip Settings, and Scratch Disks in the Log and Capture Window**

When you’re ready to recapture your media, Control-click the new offline sequence that’s been created, then choose Batch Capture from the shortcut menu. When the Log and Capture window appears, specify the appropriate settings in the Capture Settings and Clip Settings tabs to make sure that you capture your media appropriately. When you’re ready, proceed with the capture, inserting each tape reel as Final Cut Pro requests it.

For more information, see the Final Cut Pro documentation.

### **Reconforming via Telecine Retransfer**

If the media you used for the offline edit was transferred at less than optimum quality via an inexpensive one-light transfer, you need to retransfer the clips used in your sequence at higher quality so you can create the final master. To do this, you use the Export Cinema Tools Film Lists command in Final Cut Pro to export the information that will be used to retransfer the shots used in the edit. When you give this information to the transfer facility, the telecine operator can do a best-light or safety transfer of your selects onto new tapes with matching timecode, which you then reingest for finishing.

Whenever you work with another facility, it’s best to discuss your workflow and the facility’s needs in advance, to make sure you’re able to provide everything that’s required.

### Stage 1: Preparing Your Sequence to Export a Pull List

There are a few things you can do to better organize your sequence in preparation for exporting a film list for retransferring and reconfirming your program.

- *Manually remove unused clips from your sequence:* Time is money during a film-to-tape transfer session, and the fewer shots you have to transfer, the faster the transfer will go. One easy way you can facilitate this process is to move all video clips that aren't being superimposed as part of an effect or compositing operation down to track V1. This action overwrites any hidden video items that appear underneath clips on higher video tracks (either partially or completely) that aren't really part of the edit. To make sure that all video items in the topmost video tracks correctly overwrite the hidden parts of clips in lower video tracks, move them down one track at a time; for example, move any noncomposited items in track V4 down to V3, then move all noncomposited items in track V3 down to V2, and finally move all of the noncomposited items in track V2 to V1. This process also nicely organizes the sequence for color correction later.
- *Do not use the Media Manager to rename or remove unused media:* Although it's a good idea to manually remove unused media from the Timeline, *do not* use the Media Manager to either rename or delete unused media in your project. If you do, you'll lose the ability to export accurate pull lists from Final Cut Pro or Cinema Tools.
- *Organize clips that aren't deliberately superimposed using the fewest possible tracks:* The various film lists that you can export can consist of only one track. This is another reason to move all clips that aren't being superimposed as part of an effect or compositing operation down to track V1. Don't worry if your sequence has many superimposed clips; each track can be exported as a separate list. Organizing all superimposed clips in as few video tracks as possible minimizes the number of lists you need to export.
- *Move all video clips that didn't originally come from film to a separate video track:* To keep your exported film lists tidy, it's best to move all clips that didn't originate from film to another video track so that they remain in the Timeline but are excluded from the exported list. This includes generators, still images, and imported motion graphics and animation clips that were created in other applications like Motion. This also includes clips that were transferred from film that are embedded inside Motion project clips (with the file extension .motn), because these won't show up in exported film lists.  
  
If you used transferred film clips inside Motion projects and the clips need to be retransferred, you should also provide a separate list of these clips. You'll use this list to retransfer those clips so the composites can be re-created with higher-quality media.

### Stage 2: Exporting a Pull List to Give to the Transfer Facility

After you organize your edited sequence, use the Export Cinema Tools Film Lists command to create a pull list to provide to the facility doing the film transfer. Make sure to ask in advance what information the facility requires in order to accurately retransfer the shots you need to match the clips that made the final cut.

### Stage 3: Having the Film Retransferred

The actual retransfer is fairly simple. This workflow assumes that each camera roll of film was originally transferred to a separate reel of videotape, with a *marker frame* assigned to each roll of film at a point before the first shot begins and a hole punch permanently identifying that frame. The telecine operator assigns a timecode value of XX:00:00:00 to each marker frame (where XX is an hour value that is incremented for each subsequent camera roll being transferred). The marker frame creates an absolute film frame-to-timecode reference for each roll of camera negative.

Using the pull list, the telecine operator loads each camera roll and cues up each needed section of camera negative for retransfer to tape, recording timecode for each shot that matches the same timecode that was originally transferred relative to that roll's marker frame. This makes it easy for each clip to be recaptured and relinked to your original Final Cut Pro sequence. During this second transfer, the operator makes careful adjustments to the color and contrast of each individual shot to ensure the highest-quality result.

**Important:** When retransferring film, it's important that the telecine operator maintain the same 3:2 pull-down pattern that was used during the original transfer. Otherwise, you may have problems when the fields of your online media don't line up with those of the originally edited offline media after the reconform process is finished.

### Stage 4: Reingesting and Relinking the Transferred Media

After stage 3, you'll have a series of tapes, one for each camera roll, containing only the shots specified on the pull list. Because the retransferred shots are only a subset of each camera roll, there will likely be timecode breaks between each shot. This is fine, because it's critical that the timecode for each retransferred clip match the timecode of the original offline media. Using these tapes, it's a simple matter to reingest the new high-quality media and relink it to your sequence.

For more information, see the Final Cut Pro and Cinema Tools documentation.

### Reconforming to DPX or Cineon Film Scans

This method assumes that you're using a digital intermediate (DI) workflow in order to color correct and finish your program digitally, at high resolution, in preparation for printing to film. There are many ways you can do this, but the procedures described in this section are recommended for digital intermediate workflows using Color. No matter what kind of media you use during the offline edit, in the end you'll be reconforming your project to high-quality DPX or Cineon image sequences that were scanned from the original camera negative during the finishing stage, using a datacine.

For detailed information about this workflow, see the Color documentation.

## Stage 1: Preparing Your Final Cut Pro Sequence

To ensure reliability when it comes time to reconfirm the offline edit of your project in Final Cut Pro to the source DPX media in Color, you need to be careful not to alter the timecode or reel numbers of the offline source media in any way.

Because you'll be exporting an Edit Decision List (EDL) to Color in order to relink your project to the original DPX image sequences, it's prudent to be extremely conservative and eliminate any and all transitions and effects that are not supported by the CMX EDL format, or by Color itself. You can't have superimposed clips of any kind, and you should eliminate any media not originated on film, like generators, still images, freeze frames, Motion project clips, or other effects. All of these effects need to be created separately and integrated into the final image sequence that will be printed to film later. There are two exceptions:

- Color can render cross dissolve transitions. Any other type of transition is automatically replaced with a cross dissolve of the same length as the original transition, and then rendered.
- Color can also render Pan & Scan adjustments to clip geometry.

**Note:** If you plan to export a pull list in order to retransfer the clips used in the offline edit of your project in Final Cut Pro, *do not* use the Media Manager to either rename or delete unused media in your project. If you do, you'll lose the ability to create accurate pull lists using the Cinema Tools database.

## Stage 2: Organizing the DPX Media to Which You'll Be Conforming Your Project

How you obtain the DPX media you'll use for finishing depends on how you proceeded with the offline edit. Up to this point, there are two general workflows you may have followed:

- *You used offline QuickTime conversions of prescanned DPX media:* This assumes that you created offline-resolution duplicates of the source DPX media in the format most suitable for your editing system. You'll be in good shape as long as you ensured that all the image sequence frames from each film roll were placed in directories that were named after the roll number, and that the reel number of each converted QuickTime clip matched the corresponding roll number of the source DPX image sequence. You also need to make sure that the timecode values stored in the header of each DPX file were used as each QuickTime file's timecode. Lastly, the names of the original image sequence frames should have taken the following form: SequenceName\_0123456.dpx.
- *You used telecined media for the offline edit:* If you used telecined media for the offline edit, you need to follow a workflow similar to the workflow described in "Reconfirming via Telecine Retransfer." Assuming you used a Cinema Tools database to track the correspondence between the original camera negative and the transferred offline video, you can export a pull list to give to the transfer facility. The facility uses this list to retransfer the shots in your offline edit as new DPX media using a datacine.

To ensure a smooth reconform in Color, you need to request that the timecode that identifies each frame of negative (relative to the marker frame at the beginning of the roll) be converted to frames and used to generate the filenames for each scanned DPX file, and that the timecode also be written into the DPX header of each shot. The names of the resulting image sequence frames should take the following form:  
SequenceName\_0123456.dpx.

Lastly, each image sequence from a particular film roll should be placed into a directory that is named with the number of that roll. There should be a separate directory for each roll of camera negative that is scanned.

### **Stage 3: Exporting an EDL**

When you finish preparing your sequence and getting the DPX media ready, you need to generate an EDL in the CMX 340, CMX 3600, or GVG 4 Plus format that you can use in Color. You *cannot* use the Send To Color command to move projects to Color that are being reconformed to DPX or Cineon media.

### **Stage 4: Importing the EDL into Color and Relinking to the High-Quality DPX Media**

Use the Import EDL command in Color to import the EDL. In the Import EDL dialog, you also specify the directory where the original high-resolution source media is located, so that the EDL is imported and the source media is relinked in one step.

### **Stage 5: Grading and Outputting from Color, or Sending Back to Final Cut Pro**

At this point, you're ready to grade your program in Color. When you finish, you have two options:

- *Render DPX media for film printing:* You can render DPX media, in which case you'll later follow the procedures for gathering the rendered media in order to assemble a single, continuous image sequence that can be printed to film.
- *Render QuickTime media for video output:* You can render QuickTime files, in which case you have the option of sending your project back to Final Cut Pro for further finishing and output to video.

## **Creating Final Broadcast Design Elements and Effects**

The finishing process is also the time to replace any temporary or placeholder effects, broadcast design animations, and stills with the final versions you'll use for mastering and outputting.

When creating your final effects clips, it's usually best to render them using a mastering-quality codec (such as one of the Apple ProRes or Uncompressed codecs), regardless of which codec you're using for the rest of the media in your program. For example, if you've reconformed your sequence to use the originally shot DV-25 media, it's still preferable to render your effects clips using a higher-quality codec to avoid introducing unnecessary compression artifacts.

The finishing process can also result in changes to sequence resolution that may have an impact on the different kinds of effects clips you may use in your program.

Related topics include:

- “Creating High-Quality Slow-Motion Clips Using Motion”
- “Using Effects in Offline/Online Workflows That Change Resolutions”
- “When a Color Roundtrip Changes Sequence Resolution”

### Creating High-Quality Slow-Motion Clips Using Motion

If there are clips using linear or variable slow-motion speed effects in your sequence, you have the option of rendering them at a much higher quality using the optical flow image analysis capabilities of Motion. This feature lets you easily create extremely smooth slow-motion effects.

To do so, send any clip that uses linear or variable speed effects to Motion. Variable speed keyframes are converted automatically to their Motion equivalent. When Motion opens, select the clip, open the Timing parameter group in the Inspector, and set the Frame Blending parameter to Optical Flow.

It may take a moment for Motion to analyze the clip. This is a necessary step for achieving completely smooth slow-motion effects. Once the analysis is complete, there are two ways you can incorporate the effect back into your edited sequence:

- You can save the Motion project and go back to Final Cut Pro. A Motion project clip for that project is embedded in the Timeline when you send the clip to Motion, and you can simply render it in the Timeline and output your program as is.
- If you plan to grade your project using Color, which isn’t compatible with Motion project clips, you instead need to export the clip from Motion as a QuickTime file using whichever codec you intend to master your program with. You then reimport the clip into your Final Cut Pro project and reedit it into your sequence to replace the original clip and speed effect.

### Using Effects in Offline/Online Workflows That Change Resolutions

Media Manager operations performed during the process of reconforming a program can sometimes change a sequence’s resolution. For example, if you have HD source media but performed the offline edit using downconverted media at an SD resolution, you can use the Media Manager to create an offline duplicate of your sequence that uses an online-quality sequence preset in preparation for reconforming the original HD media. If a Media Manager operation such as Create Offline changes the resolution of a sequence, the Motion tab attributes of every clip in that sequence are adjusted proportionally to match the new frame size.



A sequence's resolution is usually changed in preparation for recapturing or retransferring higher-resolution media; this change in resolution is necessary to match the sequence to the native resolution of the new online media. However, this also means that generators (such as title generators), still images, embedded Motion projects, and animation created using Final Cut Pro Motion tab settings are all scaled to the new size of the sequence. Most of the time, this is a seamless change because each clip's geometry is calculated relative to its center.

However, if a resolution or media change results in a mismatch between a clip's resolution and that of the sequence it's edited into, you can use the Conform to Sequence command to make the size and aspect ratio of the clip match those of the sequence.

*Tip:* To simplify the reconforming process, it's easiest to plan an offline/online workflow in which the frame size doesn't change. This is the reason for the Apple ProRes 422 (LT) and Apple ProRes 422 (Proxy) codecs, as they both let you capture offline-quality, low-bandwidth media at the full frame size of your final program.

## When a Color Roundtrip Changes Sequence Resolution

Most of the time, a Final Cut Pro-to-Color roundtrip has a fairly transparent effect on the resolution of your final sequence in Final Cut Pro. However, there are instances when the sequence that is returned has a different resolution than the one that was originally sent. This section describes those instances and how they affect your workflow.

### When does a Final Cut Pro-to-Color roundtrip automatically change the resolution of a sequence?

If you render your color-corrected media using a codec different from that of your source media (one of the Apple ProRes or Uncompressed codecs, for instance), all anamorphic media in your project is resized to the closest full-raster frame size. For example, media using the anamorphic 1280 x 1080 or 1440 x 1080 frame size is rendered using the standard 1920 x 1080 frame size.

Whenever rendering your media in Color changes the codec, the frame size, or both, a dialog appears when you send your project to Final Cut Pro, asking if you want to change the graded Final Cut Pro sequence to match the QuickTime export codec.

- *If you click Yes:* The codec used by the sequence sent to Final Cut Pro is changed from the one that was originally sent to Color. Also, the frame size of the sequence changes to match the frame size of the rendered media. You may need to use the Conform to Sequence command on generators, embedded Motion projects, and other clips that weren't altered by Color if they reappear at the original frame size.

- *If you click No:* The settings of the sequence that Color sends back to Final Cut Pro are identical to those of the sequence that was originally sent to Color, but the codec used by the clips doesn't match that of the sequence, and the scale and aspect ratio of the rendered clips change to fit the original frame size. All clips conform to the original frame size, but clips that were rendered by Color may also need to be rendered in Final Cut Pro because their Scale and Aspect Ratio parameters are altered.

### **What happens to clips if you manually change the project resolution in Color?**

A change to project resolution may happen if you're working with 2K or 4K native RED QuickTime or DPX media, and you decide to change the project to an SD or HD resolution so you can send it back to Final Cut Pro for video output. Whenever you manually change a Color project's resolution, a dialog appears asking if you want Color to automatically scale your clips to the new resolution.

- *If you click Yes:* Every clip's Scale parameter is changed automatically in the Pan & Scan tab of the Geometry room to conform to the new resolution, letterboxing or pillarboxing clips as necessary to avoid cropping.
- *If you click No:* The Scale parameter of each clip is unchanged, but the image may be cropped if the new resolution is smaller than the previous resolution.

### **How is media rendered in Color if the project resolution changes?**

Whenever a Color project's resolution preset is changed to a different frame size, the effect on the final media that's rendered depends on what kind of source media you're using.

- *If you're rendering QuickTime media:* Each shot in your project is rendered at the frame size of the original source media. The new resolution preset you choose affects only the resolution of the sequence that is sent back to Final Cut Pro. Each clip's Pan & Scan settings are converted to Motion tab settings when the project is sent back to Final Cut Pro.
- *If your project uses 4K native RED QuickTime media:* If your project uses 4K native RED QuickTime media, each shot in your project is rendered at the new resolution you've specified. Any Pan & Scan tab adjustments you've made are also "baked" into the final media. (2K native RED QuickTime media is rendered in the same way as other QuickTime media.)

## **Color Correction**

Color correction (or grading) is the process of making adjustments to the color and contrast of the shots in your program in order to:

- Fix problem clips that may be too bright or too dark, or that have improper color
- Even out the color and contrast of each of the shots in a scene so they all look as if they occur in the same place at the same time

- Bring attention to specific elements in the frame
- Make creative adjustments to stylize the appearance of the images

In most post-production workflows, color correction is one of the last steps taken to finish a program's visuals. Ideally, your edit should be locked before you move on to this stage, especially if you're sending your sequence to Color. Although you can use Color to reconfirm a project based on changes made to the sequence that was originally sent, it's considerably more efficient if you are able to complete and lock the edit so that this isn't necessary.

You have three choices in color correcting your project. For more information, see:

- *"Color Correcting a Program in Final Cut Pro"*
- *"Sending a Project to Color"*
- *"Delivering a Program to Another Facility for Grading"*

## Make Sure You Have the Right Setup for Color Correction

If you plan to do your own color correction, it's important to make sure that you have the right room and equipment for the job. Remember that you will be the last word in how the picture looks, and the audience is going to see exactly what you render. When deciding how to equip your room, keep the following essentials in mind.

- *A color-critical monitor:* Because every adjustment you make is based on your impressions of the image on your broadcast monitor, it's important that, at the very least, you have a monitor with the following capabilities: an accurate color gamut, appropriately deep blacks and a wide contrast range (so black doesn't look like gray), user-selectable color temperature (typically 6500 K or 9300 K, depending on your region), adherence to Rec. 601 and Rec. 709 standards as necessary, and controls that are appropriate for regular calibration to keep your monitor standards-compliant.
- *A compatible graphics card and video interface:* Color uses the graphics processing unit (GPU) of your graphics card to do its processing, so you need to make sure that your graphics card meets the Color requirements. For monitoring in either Final Cut Pro or Color, you also need a video capture card or broadcast video interface that's compatible with Color and that can output a signal that's appropriate for critical monitoring. Appropriate interfaces include Y'P<sub>B</sub>P<sub>R</sub> SDI, HD-SDI, and HDMI.
- *Hardware scopes for quality control:* The video scopes that Final Cut Pro and Color provide are excellent for creative decision-making and basic quality control. However, if you regularly submit video masters for terrestrial and satellite broadcast or cable distribution, it's also important to analyze the actual signal coming out of your video interface and being recorded to tape, as there can be excursions in the output signal that aren't apparent from an analysis of the internally processed signal within your computer. If intensive quality control is part of your business, a hardware scope can also provide other types of signal analysis that are beneficial.
- *A room that is properly set up for monitoring:* Lastly, it's important that the room you use for color correcting be properly set up for unbiased viewing of the image on your monitor. The wrong room can make it difficult to judge an image even if it's displayed on a great monitor. No direct light should spill on the front of your monitor. Ambient room lighting should be subdued and indirect and should match the color temperature of your monitor. The viewing area behind your monitor should be a neutral gray and should be illuminated to be no more than 10 to 20 percent of the brightness of the monitor displaying pure white.

## Color Correcting a Program in Final Cut Pro

Final Cut Pro offers a considerable tool set for color correction. Although the Final Cut Pro color correction tools are not as feature-rich as those in Color, the Color Corrector 3-way filter, in conjunction with the many other filters and compositing tools found in Final Cut Pro, allows you to do a complete color correction job. The Final Cut Pro color correction features include primary and secondary color correction, as well as many other operations such as masked corrections. In addition, there are many third-party filters available to extend the Final Cut Pro color correction tool set.

Color, on the other hand, *is* a dedicated environment for this sort of work, featuring many more tools and options for doing comprehensive grading. If you're trying to decide whether to color correct a sequence in Final Cut Pro or send it to Color, consider the following questions.

### **Are you finished editing?**

Because color correction in Final Cut Pro involves applying filters to clips in the Timeline, your color corrections travel with the clips to which they're applied. This means that clips retain their color correction if the project is reedited, without any additional effort on your part. If your project is still being edited, but you have a handful of scenes that need some basic color correction so that you can better evaluate how the editorial flow of the show is working (without the distractions that uncorrected shots may pose), doing these corrections in Final Cut Pro is an excellent solution.

### **Is your program effects-intensive?**

Sending sequences to Color frequently involves a fair amount of project preparation to ensure a seamless roundtrip. If your program contains a lot of effects—for example, many filters, superimpositions, composites, generators, embedded Motion clips, and so on—it might make sense for you to do the color correction right in Final Cut Pro rather than spend the time to prepare everything for Color.

### **Does it make sense to split the difference?**

If you have a program that combines traditional editing with isolated sections of effects-intensive work, it may make sense to separate the effects-intensive sections, which would need extensive preparation before being sent to Color. For example, you can send the majority of conventionally edited clips in tracks V1 and V2 to Color, while moving the effects-intensive sections to another sequence for color correction within Final Cut Pro. After you finish in Color, you can marry the two sets of clips back together in a single sequence. This provides you with the best of both worlds and can be the fastest way to work.

## Tips for Color Correcting in Final Cut Pro

In general, color correcting in Final Cut Pro doesn't require a lot of preparation. Still, there are a few steps you can take to make things easier.

- Move all video clips that aren't being superimposed as part of an effect or compositing operation down to track V1. This action eliminates unused media from your program and makes it easier, organizationally, to work in the Timeline.
- Use the Clip Keyframes control to display the filters bar and motion bar in the Timeline to make it easier to keep track of which clips have filters applied to them, and which ones don't, as you work your way through the program.
- Put all of the filters that you use most often into the Favorites bin and open the bin in its own tab. This saves time and eliminates the need to constantly search for the color correction filters you use most often.
- Don't forget that there's a dedicated Color Correction window layout that opens a series of video scopes to help you evaluate your clips as you make your adjustments.

After you finish color correcting your program in Final Cut Pro, you follow the usual steps to render and output your program. For more information about color correction in Final Cut Pro, see the Final Cut Pro documentation.

## Sending a Project to Color

If you want to do sophisticated color correction and you're properly equipped with a compatible system, a color-critical monitor, and the appropriate viewing environment necessary for doing this specialized task, you'll want to integrate Color into your post-production workflow. Color gives you precise control over the look of your project by providing flexible tools and an efficient workspace in which to manipulate the contrast, color, and geometry of each shot in your program.

The Final Cut Pro-to-Color roundtrip works in a very specific way.

### Stage 1: Preparing Your Sequence

Final Cut Pro-to-Color roundtrips work best when you spend time preparing your sequence first. In particular, there are certain effects for which Color has only limited compatibility, and reorganizing your sequence up front may save you frustration later.

### Stage 2: Sending Your Sequence to Color

The Send To Color command in Final Cut Pro uses XML to convert your edited Final Cut Pro sequence to a Color project. You can send only entire sequences to Color, not individual clips.

### Stage 3: Grading and Rendering Your Program

After you send your sequence to Color, you can use its dedicated tool set, in conjunction with a control surface, a color-critical monitor, and an appropriately equipped system, to grade your program. After you finish, you use the Color Render Queue to render a new, color-corrected set of media files. Color renders one new file for each shot that appears in the Timeline.

### Stage 4: Sending Your Project Back to Final Cut Pro with a New Set of Media

The Send To Final Cut Pro command in Color uses XML to convert your Color project to a *new* Final Cut Pro sequence in the original project file, with “(from Color)” appended to its name. This sequence is automatically linked to the new media that Color rendered. At this point, any effects that didn’t show up in Color reappear in Final Cut Pro, and you can put the finishing touches on the sequence (such as making final adjustments to the titles and credits and replacing the original program audio with the finished audio mix) before outputting it.

Although there’s much more dedicated workflow information in the Color documentation, here are some important highlights that you should keep in mind.

#### Preparing Your Sequence to Send to Color

Whether you’re working on your own project or preparing a client’s project in advance of a Color grading session, you should take some time to prepare the Final Cut Pro sequence you’ll be sending in order to ensure the best results and the smoothest workflow. Here are some recommendations to keep in mind.

- All clips that aren’t being composited or superimposed should be moved to track V1.
- Color Corrector 3-way filters are automatically converted to Primary In room adjustments. However, if more than one has been applied to a clip, only the last Color Corrector 3-way filter appearing in the Filters tab is converted; all others are ignored. Also, Color Corrector 3-way filters with Limit Effects turned on are ignored. Because Final Cut Pro is a  $Y'CbCr$  processing application and Color is an RGB processing application, Color Corrector 3-way conversions are only approximations and will not precisely match the original corrections made in Final Cut Pro.
- All unnecessary video filters should be removed. Video filters don’t appear in Color, but they’ll reappear when your project is sent back to Final Cut Pro, so make sure to keep the filters that are important and eliminate the filters that will be redundant after you’ve graded the program in Color.
- Dividing long projects into shorter reels may provide better performance if your program uses a high-bandwidth format like uncompressed HD, REDCODE, or DPX image sequences.

- You should export self-contained QuickTime files for effects clips that you want to color correct in context. Color doesn't support media like generators or embedded Motion clips. If you want to color correct these kinds of effects, you need to export self-contained QuickTime files and then reedit these into your sequence to replace the original effects.
- All freeze frames should be moved to track V1. Color supports only freeze frames that appear in track V1.
- If you're transporting your project to another facility, you should use the Media Manager to remove media not used in your sequence and consolidate all your files in one place.
- If you're rendering 2K or 4K DPX or Cineon media in Color and outputting it for film printing, you should restrict your sequence to using cross dissolve transitions only. Cross dissolves are the only transitions that Color renders in digital intermediate workflows.

### Rendering Your Project and Sending It Back to Final Cut Pro

As described in "Finishing Using Compressed Versus Uncompressed Media," it's typical to choose a high-quality mastering codec with which to render your color-corrected media, to ensure the highest quality for your program. Prior to rendering, you should also choose where this media is rendered (using the Project Render Directory button in the Project Settings tab of the Setup room of Color).

Sending your program back to Final Cut Pro is straightforward, but you need to keep track of the new color-corrected media that Color rendered. When you ultimately archive your project and media, it's critical to also archive the rendered Color media in addition to the source media that your project uses.

### Making Color Correction Changes After Your Project Is Back in Final Cut Pro

If you need to make revisions to the color corrections of a sequence that you've already sent from Color to Final Cut Pro, don't send the sequence named "from Color" back to Color. The correct method is to quit Final Cut Pro, reopen the originating Color project, make your changes, and then do one of the following:

- *If you didn't change the grade number used by any of the shots in Color:* Simply rerender the clips you changed, save the Color project, and then reopen the Final Cut Pro project that has the sequence that was originally sent "from Color." The rerendered media overwrites the previous media and is immediately reconnected when you reopen the Final Cut Pro project.
- *If you did change the grade number of any of the shots in Color:* You need to send the project back to Final Cut Pro and use the new "from Color" sequence to finish your program.

Following this process makes it easier to manage your media and keep track of your revisions, and also prevents any of your clips from being rendered twice unnecessarily.



## Delivering a Program to Another Facility for Grading

You can deliver your edited program to another facility for grading using third-party hardware and software. This can be advantageous because working at a facility with high-quality monitoring equipment in a specialized viewing environment lets you evaluate your program's images with remarkable accuracy. Working at a dedicated facility and using the facility's equipment frees you from having to spend the time and money to create this environment on your own. Finally, many facilities boast color correction systems that use costly dedicated hardware to provide high-end processing capabilities in real time at maximum resolution.

Typically, delivering a program to another facility for color correction works one of two ways.

### Translating Your Project Using XML

Some facilities' color correction systems have the option, using third-party utilities, of taking an exported Final Cut Pro XML file and translating it into the facility's own project file format. This is ideal, because it allows for relinking to the source material and retains edit information that lets the colorist get started quickly. Check with your facility in advance to find out what kind of media is required to accommodate the facility's workflow. One of the drawbacks of this approach is that some effects may be difficult or impossible to translate, necessitating additional project preparation in excess of what Color requires.

### Delivering a Tape Master for Tape-to-Tape Color Correction

Another frequently used approach is to deliver a tape master of your edited program and, if available, an EDL. The master tape is ingested in its entirety, and the EDL (if available) is used to "notch" the program, creating cut points and transitions to match those in the original program. The colorist can start working quickly, applying settings to individual sections of the program as if he or she were working with the original sequence.

If an EDL is not available, many color correction systems allow for automated cut detection, placing edit points wherever a cut is found in the edited program. Otherwise, it's up to the colorist to either place cut points manually or use keyframes to change grades whenever one shot ends and another begins. Check ahead to find out how the facility you'll be working with wants your materials prepared.

## Final Sound Editing, Design, and Mixing

Sound editing, design, and mixing comprise a series of activities that are geared toward polishing the audio of your program to enhance the final presentation. Never underestimate the power of a good mix. Audiences may forgive problems with a program's picture, but they'll never forgive poor audio. To clarify, audio post-production involves the following tasks:

- *Dialogue editing*: Editing dialogue involves fine-tuning lines spoken by actors and other onscreen speakers and fixing bad pronunciation, stumbled words, and other slight defects of speech.
- *Automated dialogue replacement (ADR, looping, or dubbing)*: This is the process of completely rerecording lines that were originally recorded in unsalvageable situations. For example, if there was an off-camera cement mixer in a critical location that filled the audio with noise that can't be filtered out, you can simply rerecord the dialogue later.
- *Voiceover recording*: This involves pristinely recording narration in such a way as to best capture the qualities of a speaker's voice.
- *Sound design*: This is the process of enhancing the original audio with additional sound effects and filters, such as adding car crash or door slam sound effects to a scene to replace sound that was too difficult or unimpressive to record cleanly in the field.
- *Foley recording and editing*: This is the process of recording and editing custom sound effects that are heavily synchronized to picture, such as footsteps on different surfaces, clothes rustling, fight sounds, and the handling of various noisy objects.
- *Music editing*: Whether you're using prerecorded tracks or custom-composed music, the audio needs to be edited into and synchronized to events in your program, which is the music editor's job.
- *Mixing*: This is the process of finely adjusting the levels, stereo (or surround) panning, equalization, and dynamics of all the tracks in a program to keep the audience's attention on important audio cues and dialogue and to make the other sound effects, ambience, and music tracks blend together in a seamless and harmonious whole.

These tasks may be done by individual specialists, or they may all be done by one person, but for nearly every type of program, they need to be done. The following sections cover several approaches to finishing your audio in a Final Cut Studio workflow:

- "Organizing Your Audio in Preparation for Mixing"
- "Audio Finishing Using Final Cut Pro"
- "Audio Finishing Using SoundTrack Pro"
- "Audio Finishing Using Third-Party DAW Solutions"

## Make Sure You Have the Right Setup for Mixing

If you plan to do your own sound design and mixing, it's important to make sure that you have the right supporting hardware for the job. You will be the last word in how the audio sounds, and the audience is going to hear exactly what you export. When deciding how to equip your room, keep the following essentials in mind.

- *A high-quality audio interface:* It's important to have an appropriate audio interface for routing either stereo or surround channels to your speakers. Your audio interface should be able to accommodate the bit depth of the audio you'll be working with. It should also be of high enough quality to produce a clean-sounding signal.
- *High-quality monitoring speakers:* It's crucial that you use high-quality monitoring speakers that provide accurate and unbiased imaging of your audio, with no exaggerated or omitted frequencies. This ensures that you hear problems in your audio, such as high-frequency hiss or low-frequency rumble, so that you can do something about them. It also ensures that you don't inadvertently overcompensate EQ or level settings when the fault lies with your speakers, rather than with the quality of the source audio itself.
- *Studio-quality microphones and a suitable recording environment:* If you're recording voiceover, dialogue replacement, or Foley effects, it's important to use microphones that will pleasingly capture the type of audio you need. There are many different types of microphones, and they all have different strengths and weaknesses for various applications. Just as important is the environment in which you'll be recording. It should be quiet and lack excessive reverberation. (It's usually not a good idea to record in a room that's too "live," such as a completely empty apartment in which you can hear your own slight echo.)
- *A properly balanced mixing room:* It's very important that your room have balanced acoustics so that you can accurately hear your mix; otherwise, your speakers can't do their job. Positioning your speakers and adjusting where you sit relative to the angle of the room's walls makes a big difference in how your audio sounds. Additional foam and fabric wall and ceiling treatments also affect the room's acoustics. In an ideally set up room, no one set of audio frequencies is either exaggerated or reduced; this way, you can make critical level and EQ decisions.

## Organizing Your Audio in Preparation for Mixing

Whether you do the sound design and mixing in Final Cut Pro, in Soundtrack Pro, or at another facility entirely, it's important to organize your project to facilitate the work that will be happening. In particular, there are three things you can do to make the process go smoothly.

### **Organize audio clips into tracks according to their type**

Audio editing and mixing is a lot easier if you organize the audio clips in an edited sequence into multiple tracks, based on their type. For example, it's common to put all sync-sound dialogue clips into one group of tracks (some editors put each actor's dialogue into a separate track), background ambience in another group of tracks, sound effects in another group of tracks, and music in a different group of tracks. Useful track categories include:

- Dialogue
- Voiceover
- Music
- Ambience
- Sound effects

### **Put a one-frame video flash and audio beep before the beginning and after the end of your sequence**

As an aid to checking and maintaining program sync, it's helpful to use a one-frame *2-pop* (named after the sync beep that occurs at the number 2 of a countdown reel). The beeps travel with the audio that you send to Soundtrack Pro (or a third-party digital audio workstation, or DAW). When you bring your final mix back into Final Cut Pro, you can use the first pop to line up the mixed audio with the flash frames in the sequence; the last pop confirms whether or not your sync is good for the entire duration of the mix.

### **If necessary, divide your program into reels**

It's common, but not always necessary, to divide long-form programs into reels. For example, if the program's audio will be exported as Open Media Framework (OMF) files for delivery to a mixing facility, and the program contains many high-resolution audio clips, you might need to follow this strategy because OMF files have a 2 GB file size limit. Dividing your program into reels can also serve an organizational purpose, because program reels that are considered finished and locked can be moved down the post-production pipeline to sound design and color correction, while others can continue to be edited.

### **Audio Finishing Using Final Cut Pro**

Final Cut Pro has many features that support high-quality audio editing and mixing, including subframe keyframing and syncing, per-clip level and pan controls, automated mixing using control surfaces, and audio filters for common tasks such as equalization and compression. One advantage of finishing your audio inside Final Cut Pro is that you don't have to do a roundtrip between Final Cut Pro and Soundtrack Pro. You can simply continue working in the Timeline, and when you finish with the audio, you're ready to render and output your program.

For more information about mixing your sequence right in the Timeline, see the Final Cut Pro documentation.

Soundtrack Pro, on the other hand, *is* a dedicated environment for this sort of work and offers many more tools and options for sound design, noise suppression and filtration, and mixing. If you're trying to decide whether to mix a sequence in Final Cut Pro or send it to Soundtrack Pro, consider the following questions.

#### **How complicated is your audio?**

If your audio needs are fairly straightforward, and you're pretty happy with the way your audio sounds, there may be no need to send it to Soundtrack Pro for finishing. Final Cut Pro has all the tools you need to do a high-quality stereo mix, and if isolated clips require more work, you can always send those to Soundtrack Pro for individual adjustment. (See "Sending Specific Clips to Soundtrack Pro for Cleanup.")

If, however, your project is more complicated, it may be to your advantage to move all of your tracks to Soundtrack Pro to do more intricate work. See "Audio Finishing Using SoundTrack Pro."

#### **Do you need a surround mix?**

If you require the features necessary to create a surround mix, you'll be best served by working in Soundtrack Pro, which has surround panner and mixdown support as well as filter support for surround imaging. For more information about surround mixing, see the Soundtrack Pro documentation.

### **Audio Finishing Using SoundTrack Pro**

Soundtrack Pro is a dedicated audio editing and mixing application that provides all the software tools you need for dialogue editing and sound design, with features designed to facilitate audio/video synchronization, in-place sound editing, automated dialogue replacement (ADR), and sound effects library management.

Tools for taking corrective measures include tools for noise reduction, click and pop removal, equalization matching, and de-essing, among many others. After you have edited the audio and fixed any problems, there are numerous features designed to help you create the final mix. Support for automated mixing using control surfaces, bussing for submixes, surround panning, and a complete assortment of professional-quality filters for equalization (including channel and parametric EQ), dynamics (with several methods of compression and expansion), and stereo and surround imaging round out the Soundtrack Pro feature set.

With this in mind, sending all of your sequence's audio to Soundtrack Pro is an easy process.

**Note:** It's typical for the sound mix and color correction of a program to be done at the same time. As with color correction, it's most efficient to *lock the edit* prior to starting work on your soundtrack. However, reconforming a sound edit that's in progress to match changes made to the video is a common occurrence, and Soundtrack Pro provides a powerful reconforming tool for streamlining this process using the Final Cut Pro XML Interchange Format. For more information, see the Soundtrack Pro documentation.

### **Stage 1: Organizing Your Audio Tracks**

You'll be able to work most efficiently if you take the time to organize the various dialogue, sound effects, ambience, and music clips in your sequence into separate tracks. For more information, see "Organizing Your Audio in Preparation for Mixing."

### **Stage 2: Sending All Audio Tracks to Soundtrack Pro**

The easiest way to send all of the audio tracks in your sequence to Soundtrack Pro is to select your sequence in the Final Cut Pro Browser and then use the Send To Soundtrack Pro Multitrack Project command in Final Cut Pro. A dialog appears, giving you options to choose a location and provide a name for the newly created Soundtrack Pro project, open it after sending, and include background video to use as a reference while you work in Soundtrack Pro.

During the process of sending the audio tracks to Soundtrack Pro, the following clip parameters are translated into their Soundtrack Pro equivalents:

- Audio levels, including keyframes
- Left/right channel pan settings, including keyframes
- Scoring markers

### **Stage 3: Sound Editing and Mixing**

When you open the new Soundtrack Pro project, you see a series of tracks and clips that match those from the original sequence in Final Cut Pro. At this point, you can edit these audio clips any way you like, regardless of their original position in the Timeline.

As you work on your program's audio, you can add more tracks and audio clips to those that were sent from Final Cut Pro. You can incorporate sound effects and ambience tracks from the Soundtrack Pro library or from other sound effects collections; record dialogue replacement, voiceover, or Foley effects; and import music created by applications like Logic and GarageBand that has been exported as AIFF and WAVE files.

When you finish, make sure you save the Soundtrack Pro project one last time before sending the results back to Final Cut Pro.

#### Stage 4: Sending the Final Mixdown to Final Cut Pro

When you finish with the final mix, there are two ways you can send the mixdown back to Final Cut Pro for use in your sequence.

- *Export audio media:* You can export one or more AIFF or WAVE files of the master mix (or any combination of individual submixes) using the Export command in Soundtrack Pro. After the export process is finished, you can open your original Final Cut Pro project, import the audio mix file or files, and edit the files into your original sequence to synchronize with your video.
- *Automatically send your mixdown to a new Final Cut Pro sequence:* You can also use the Export command in Soundtrack Pro to send your mixdown tracks straight to Final Cut Pro. When the Export dialog appears, specify your settings, then choose “Send files to Final Cut Pro sequence” from the After Export pop-up menu. Final Cut Pro opens, and the Import XML dialog appears. Specify the appropriate settings for your program and click OK. A copy of your original sequence is created in the Browser, with the mixdown audio correctly synchronized to your clips in the Timeline and the original audio tracks muted.

#### Audio Finishing Using Third-Party DAW Solutions

Although Final Cut Pro and Soundtrack Pro are both suitable environments for creating high-quality mixes, if you’re not comfortable doing your own audio work, consider sending your audio to a specialized post-production facility that uses other digital audio workstation (DAW) hardware and software combinations. Working with a specialized facility also gives you the opportunity of having your audio worked on in a dedicated room with specifically designed acoustics for mixing, as well as high-quality monitoring speakers and support equipment.

It’s always important to edit the audio clips you want for continuity and to catch any obvious editorial fixes, such as mispronounced words. However, if you decide to use an outside facility for the final sound design and mix, it’s best to leave the audio in your edited sequence otherwise untouched. Don’t add audio filters and don’t overedit your audio (that will be the dialogue editor’s job). When working with a facility, export your edited audio tracks in an organized state so that the audio specialists can import the audio into their system and quickly get to work. All filtering, mixing, and fine editing will be done there.

**Note:** It’s typical for the sound mix and color correction of a program to be done at the same time. As with color correction, it’s most efficient to *lock the edit* prior to delivering the materials necessary for a facility to start working on your soundtrack. Reconforming a sound edit that’s in progress to match changes made to the video is a common occurrence, but it can be labor-intensive and costly.

## Delivering Your Program Materials

When you work with another facility to do the audio, you're usually asked to provide the following:

- *A reference video:* You need to provide a reference video so that the sound designer and mixer can time their work to picture. This can be either an exported QuickTime movie or a tape output, depending on how the facility is equipped. In either case, you may need to provide a timecode window burn, which you can create in Final Cut Pro by applying the Timecode Reader filter to a nested instance of your edited sequence prior to output. Ask in advance what is preferred.
- *An OMF export of the project audio:* Open Media Framework (OMF) is a cross-platform file format for exchanging video and audio sequence information between editing systems. Avid originally developed the OMF file format, and many editing applications have incorporated some level of OMF import and export compatibility. OMF is most often used for moving track, level, pan, and audio clip information from video editing systems into audio post-production applications. OMF files can export as many audio tracks as your sequence contains; however, there's a 2 GB limit on the size of OMF files, so it may be necessary to work in reels if your program is very long and has an excessive number of audio items.

## Marrying the Final Mix Back to Your Video

When the facility is finished with your mix, you typically receive a set of AIFF or WAVE files that contain all of the channels for the final mix. You simply need to import these audio files into your Final Cut Pro project and edit the audio back into your sequence to line up with the program video. If you placed 2-pops at the head and tail of your program, these can help you resync the final mix in the event that the start time of your sequence has changed. The 2-pops also provide an immediate reference for whether the audio sync is still good throughout the mix.

Alternatively, if your workflow requires that you output your program to videotape prior to completing the audio (for example, if you have tape-to-tape color correction done at another facility), you can also arrange to have your mixed audio "laid back" to your master tapes. If this is necessary, inquire with the facility doing the work about what it will involve for your program.

For more information about exporting video and OMF files, see the Final Cut Pro documentation.



This chapter covers the following:

- What Is Mastering? (p. 97)
- Creating Versions of a Program with and Without Titles (p. 98)
- Format Conversion (p. 99)
- Subtitling and Closed Captioning (p. 100)
- Delivering Audio (p. 105)

This chapter provides information about mastering your program. Proper mastering ensures that you provide all of the elements needed for delivery to a network or distributor.

## What Is Mastering?

In a comprehensive post-production pipeline, mastering is an extension of the finishing process that involves assembling all of the elements (or deliverables) that are required by a network or distributor into a single package.

Required deliverables may include any combination of the following:

- Separate versions of the video master with and without titles (also called *texted* and *textless* masters)
- Videotape masters in multiple formats, including a combination of high definition (HD), standard definition (SD), NTSC, and PAL formats
- Subtitling and closed captioning
- Multiple versions of the final audio mix

The network or distributor can use these elements to facilitate long-term archiving of a program into its content library, provide easy format conversion from one video standard to another, and accommodate both domestic and international distribution.

Final Cut Studio provides the capabilities for addressing most, if not all, of these needs.

For more information, see:

- “Creating Versions of a Program with and Without Titles”
- “Format Conversion”

- “Subtitling and Closed Captioning”
- “Delivering Audio”

## Creating Versions of a Program with and Without Titles

A common requirement, especially from networks and broadcasters, is that you provide separate tape masters of your program with and without titles (also called *texted* and *textless* masters).

- A *texted* master is simply your program as you intend the audience to see it, with all titles, subtitles, lower thirds, segment and interstitial titles, and end credits intact.
- A *textless* master is the same program with all titles, subtitles, lower thirds, segment and interstitial titles, and end credits removed, to facilitate easy title replacement for international distribution. (Text that appears within video clips used by the program is usually left intact.)

To make it easy to output both *texted* and *textless* versions of your program, it’s a good idea to edit all titles being used in your program into a separate set of video tracks. You can then turn off all your titles at once using the Track Visibility controls in Final Cut Pro.

### Separate Titling Requirements for SD and HD Video

If you’re expected to provide both standard definition (SD) and high definition (HD) tape masters, be aware that some broadcasters have different titling requirements for each format. The reason for this is that titles are often sized and framed specifically for HD, widescreen presentation. However, the same titles will look too small, or be forced outside of the title safe area of the picture, if that master is downconverted to SD video.

In general, there are two ways broadcasters handle this issue:

- Sometimes you’re required to use separate title templates to create both SD and HD versions of every title, lower third, and credit in your program. In this case, you need to output two versions of your program from Final Cut Pro, one with SD titles edited in and another with HD titles edited in.
- Other distributors require that you use title templates that are 4:3 safe at HD resolution and that you size your title text large enough to remain legible after downconversion. In this case, you can output only an HD version, and an SD version can be easily dubbed and downconverted from that.

Check with your distributor to find out which method is required.

## Format Conversion

Broadcasters and distributors usually request that you deliver tape masters of your program in multiple formats. Typically, the required conversions from your program's original format include:

- *HD-to-SD downconversion:* Although most broadcasters require HD tape masters, the reality is that there is still a huge audience that is limited to SD programming. Fortunately, this conversion is extremely easy to do at high quality in several ways: using Final Cut Pro, using Compressor, or using most Final Cut Pro-compatible video output cards or interfaces.
- *SD-to-HD upconversion:* If your program was acquired and finished at standard definition, you may be asked to provide an HD tape master. You can achieve a high-quality upconversion either by using Compressor prior to tape output or by using third-party video processing hardware during tape output.
- *NTSC-to-PAL conversion:* If your program is being shipped immediately for international broadcast, you may be required to provide both NTSC and PAL tape masters. Depending on your situation, you can convert your program using Compressor prior to tape output, or via third-party video-processing hardware during tape output.
- *23.98 fps-to-broadcast frame rate conversion:* Most broadcasters don't transmit programs at a progressive 23.98 fps. Although you may be required to deliver a 23.98 fps tape master for archiving purposes, you're usually required to deliver a 29.97 or 59.94 fps (for NTSC) or 25 or 50 fps (for PAL) tape master that can be sent to broadcast. You can convert 23.98 fps video to NTSC video using a Final Cut Pro-compatible video output card or interface, or third-party video-processing hardware, that can add 3:2 pull-down to the video signal as it is output to tape for a smooth frame rate conversion.

The following sections describe in more detail the two primary methods you can use for format conversion.

### Perform format conversion using Compressor

When using the highest-quality processing settings employing optical flow analysis, Compressor is capable of creating extremely high-quality format conversions. It's an excellent choice when converting a handful of clips to match the dominant format of your sequence. The same settings are also useful for converting a program to another format.

Keep in mind that, because Compressor is a software-based solution, the highest-quality processing options are also the most time-consuming. However, you can significantly speed up this processing by having a fast multicore system and by using Apple Qmaster to create a distributed processing cluster. This cluster uses as many of your computer's processing cores as you assign to it, as well as those of other computers available on your network.

For more information about using Compressor to do high-quality format conversion, see “Format Conversion When Finishing Mixed-Format Sequences.” Also see the *Distributed Processing Setup Guide*, available in Compressor Help and Apple Qmaster Help, for more information about setting up an Apple Qmaster distributed processing system.

### **Perform format conversion using dedicated hardware**

If your time is limited and you need a real-time conversion of a long-form program, it may be more efficient to use hardware to do the necessary format conversion.

There are many options. Some video capture cards, including those from AJA and Blackmagic, are capable of doing downconversion and upconversion in real time as a program is output to tape. Another solution is to use a dedicated video processor, such as those offered by Teranex and Snell & Wilcox. Dedicated video processors use a variety of advanced processing techniques to create a high-quality result.

It’s important to do a bit of research to determine the best solution for the type of format conversion you need. Some video processors that do excellent SD-to-HD conversion may not be the best choice for doing NTSC-to-PAL conversion. In addition, some broadcasters require that you use specific hardware for a particular type of conversion. Make sure to inquire about your distributor’s requirements in advance, or contact the post-production facility that will be doing the output to tape for more information about what’s best for you.

## **Subtitling and Closed Captioning**

Broadcasters and distributors often have specific requirements about including closed captions and subtitles with a program that you’re delivering for broadcast, for DVD replication, or for archiving.

In the U.S., closed captioning for broadcast is mandated by the Federal Communications Commission (FCC). If you’re delivering tape masters for broadcast, closed captioning may be an important consideration. Subtitles are usually provided as a convenience, although translation to a country’s native language may be required for film festival or theatrical exhibition and will certainly enhance your ability to find theatrical or DVD distribution there.

For more information, see:

- “Handling Closed Captioning”
- “Handling Subtitles”

## Handling Closed Captioning

Closed captioning is a subtitling system designed to make television more accessible to the hearing-impaired. Unlike movie subtitles, which are intended to translate dialogue for people who can hear the rest of the soundtrack, closed captions need to convey all important sound effects, music cues, nonverbal expressions, and dialogue that occur as a program plays.

The FCC mandates that distributors of programming for residential use must provide a minimum number of hours of closed-captioned programming per calendar quarter. This rule affects terrestrial and satellite broadcasters as well as cable operators. Although there are exceptions, the result is that many broadcasters insist on a closed-captioned tape master as one of their deliverables.

Closed captioning is encoded in a variety of ways, depending on the video format.

- *SD analog and digital NTSC broadcast, tape, and DVDs:* Closed captioning for SD analog television is a text-only data stream that's encoded into line 21 of an NTSC video signal. This is one of the reasons for the series of blinking dashes and lines that runs along the edge of a video image when you put a monitor into underscan mode. SD digital video uses the CEA-608 standard of closed captioning, which can be encoded into an MPEG-2 stream. Because closed captioning is encoded right into the video signal, it can be included and recorded on videotapes; broadcast over the air, via satellite or cable; included on DVDs; and even recorded using digital video recorders (DVRs) such as TIVO.
- *SD and HD digital television broadcast and tape:* Although high definition television (HDTV) originally supported line 21–style closed captioning, the proliferation of new HD digital video formats necessitated a new approach. To accommodate HD video encoded using a variety of methods, the EIA-708 closed captioning standard for ATSC digital television was developed. This standard has since been superseded by CEA-708, which covers both SD and HD digital television. In this standard, closed captioning data is stored in the vertical ancillary (VANC) data of a digital video stream. Final Cut Pro and Compressor both support the embedding of CEA-608 closed captioning within the CEA-708 standard.
- *European television:* Closed captioning in European television is based on teletext, a text-only information retrieval system for television originally developed in England. Digital broadcasters in Europe currently use the DVB-T and DVB-S standards for encoding teletext-style data into digital video streams. Final Cut Studio does not support these standards.

Closed captioning is actually displayed by the television receiving the video signal, which means that it can be turned on and off at will. This also means that the font and style of the closed captioning is dependent on the television. Closed captions are simply plain text.

### Capturing Video with Closed Captioning Using Final Cut Pro

If you're using a video capture card that supports the preservation of closed captioning, closed captioning is preserved during capture in one of two ways:

- The Apple ProRes codecs support the capture and preservation of either line 21 or VANC closed captioning data, including both the CEA-608 (for SD) and CEA-708 (for HD) standards of closed captioning.
- Apple's 8- and 10-bit Uncompressed 4:2:2 codecs preserve line 21 closed captioning. However, the Apple Uncompressed codecs do not preserve VANC closed captioning data directly. Instead, if VANC closed captioning is present in a video signal being captured, it is extracted and preserved via a QuickTime closed captioning track.

### Outputting Video with Closed Captioning Using Final Cut Pro

When outputting to tape, either CEA-608 or CEA-708 closed captioning can be encoded to the video stream being output using the Closed Captions controls in the Print to Video and Edit to Tape windows. Select "Insert closed captioning data from file," click the Choose File button, and choose one of the following:

- A Scenarist-formatted file (with an .scc extension)
- A QuickTime file with a closed captioning track

Scenarist files are always CEA-608 encoded. This means that if you output a program with a Scenarist-formatted closed captioning file to an HD tape format, Final Cut Pro outputs CEA-708 closed captioning that "carries" CEA-608-formatted closed captioning (supported by QuickTime 7.6 and later).

However, you can use a third-party utility (such as CPC MacCaption) to reformat CEA-608 closed captioning as true CEA-708-encoded closed captioning, saving the result as a QuickTime closed captioning track that you can use for output instead.

### Adding Closed Captioning Using Compressor

Using Compressor, you can insert a closed caption track into a movie file being encoded by choosing either a Scenarist file (identifiable by the .scc file extension) or a QuickTime file with a closed caption track. These options are available in the Additional Information tab of the Inspector window and let you include closed captioning in the following formats:

- *For QuickTime output:* Compressor can add a closed caption file as a CEA-608 closed caption track within the QuickTime output file. Closed captions can be viewed using QuickTime Player (version 7.2 or later).

- *For MPEG-2 elementary stream output:* Compressor embeds CEA-608 closed captioning data in an elementary MPEG-2 video stream so that it can be used for authoring in DVD Studio Pro. DVD Studio Pro retains this closed captioning data when the video stream is added to a track of a standard definition NTSC DVD project. You can use Apple DVD Player to play the resulting DVD Studio Pro build files to verify that the closed captioning data is present.
- *For MPEG-2 program and transport stream output:* Compressor embeds the closed captioning data in program and transport MPEG-2 streams using the CEA-708 standard.

The timecode values used to synchronize the text with the video must be based on those of the source media file being encoded. Scenarist files contain timecode-delineated lines of closed captioning data in two-byte hexadecimal format. These files are not easily readable and are typically created using specialized third-party applications.

### Adding Closed Captioning Using Third-Party Utilities and Hardware

There are third-party applications, such as MacCaption from CPC, that provide the means to import transcripts, edit them with timing information, encode closed captioning data in the necessary format, and insert the closed captioning data into a QuickTime file in preparation for tape output or DVD encoding.

### Having Someone Else Do It

It's very common to have another post-production facility take care of your closed captioning needs. Some facilities do all the transcribing, whereas others request a transcript prepared in advance. Some facilities do the insertion while outputting the program to tape, and others can insert closed captioning onto a previously recorded videotape.

### Handling Subtitles

Subtitling is usually done for the purpose of translating either particular scenes or an entire program. It may be done because the dialogue is in another language or because the dialogue is simply unintelligible to the intended audience. If you need to add subtitles to your program, there are two primary methods using Final Cut Studio.

### Adding Subtitles Using Text Generators in Final Cut Pro

The easiest way to add permanent subtitles (sometimes called *open captioning*) to your program is also the most time-consuming: editing superimposed text generators into your sequence one at a time. If you follow this workflow, it's best to add one or two dedicated video tracks to contain every subtitle you create. You can then easily turn them all off and on at once using the Track Visibility controls.

**Tip:** If you're adding subtitles manually, consider using a master template created in Motion. This way, you can easily change the look or formatting of all your subtitles at once, if necessary. For more information, see "Using Master Templates in Final Cut Pro."

You can also use a third-party utility. Most subtitling utilities take advantage of the Final Cut Pro XML Interchange Format to automate the process of creating subtitles to match a timed script that you provide. Some subtitling utilities provide an interface for actually assembling the script, whereas others require one that's premade. Most of these utilities use one of two approaches. Some facilitate the automated placement of text generators within your sequence, whereas others automatically create TIFF graphics that are edited into your sequence. Do a bit of research to determine which of these approaches best suits your needs.

### **Adding Subtitles in DVD Studio Pro**

The DVD standard is designed to accommodate up to 32 subtitle streams, which makes it possible to offer subtitles in multiple languages for international distribution. The viewer is then able to select the appropriate language to view using the DVD player's controls.

There are two ways you can create subtitles in DVD Studio Pro. You can create them manually, one at a time, by entering timecode values or dragging in the Timeline and then setting the position, font, size, style, color, and start and end fades of each subtitle.

You can also import specially formatted files that contain all of the subtitles for a particular video track. DVD Studio Pro supports subtitle files in the following formats:

- *STL*: The Spruce Technologies subtitle format
- *SON*: The Sonic Solutions bitmap-based format
- *TXT*: A plain text file
- *SCR*: The Daikin U.S. Comtec Laboratories Scenarist bitmap-based format

The timecode values used to synchronize the text with the video must be based on those of the encoded MPEG-2 program.

### **Adding Text Tracks to QuickTime Movies**

QuickTime supports dedicated text tracks that can be turned on and off by the viewer within QuickTime Player. These text tracks are useful for programs intended for Internet distribution. The QuickTime format supports multiple text tracks that users can switch among, and individual text tracks can be identified as one of a standardized list of languages, to provide international support. Additionally, text in QuickTime text tracks can be extensively formatted using a variety of descriptors for font, size, color, background, justification, aliasing, and so on. These options make QuickTime text tracks extremely versatile for multimedia use.

Text tracks can be formatted by hand in any text editor and then inserted into a QuickTime movie using QuickTime Player. For more information, go to <http://www.apple.com/quicktime/tutorials/texttracks.html>. You can also use one of several third-party utilities to create and format text tracks in a more structured fashion.



## Delivering Audio

Because of the variety of ways that audio can be mixed into various multichannel configurations, there are numerous methods for delivering your program's audio to the distributor or broadcaster. Programs that will be aired internationally have additional deliverables that must be taken into account. For more information, see:

- “What Type of Audio Mix Is Required?”
- “Alternative Audio Mixes for International Distribution”

### What Type of Audio Mix Is Required?

There are several kinds of audio mixes you might produce for your program. Each type of mix must be output to tape differently, which means you'll have different delivery requirements from various broadcasters depending on how your mix was done. Before you master your final tape, make sure to find out how your distributor wants the audio channels packaged.

The following sections describe typical mixes you might encounter.

#### Stereo

A stereo mix uses two channels (left and right) to create a directional sound field that can place audio cues anywhere along a virtual plane to the front of the listener. All Final Cut Studio applications that support audio mixing are capable of accommodating stereo audio, and virtually every program produced for television, theatrical distribution, and radio is delivered with at least a stereo soundtrack, even if the directionality of the sound field is not aggressively used.

Stereo mixes can be created easily in both Final Cut Pro and Soundtrack Pro and can be output to any tape format currently in use, encoded on a DVD, or included with a movie being delivered to the web.

#### 5.1 Surround

Surround sound is a considerably more deluxe treatment for your program's audio. The name *5.1 surround* refers to the five audio channels (left, right, center, left surround, and right surround) that create a directional sound field in which audio cues may be spatially placed anywhere around the listener; the .1 refers to the low-frequency effects (LFE) channel that's dedicated to the kind of sternum-vibrating rumbles frequently employed by explosions and other percussive sounds in action movies.

When appropriately mixed, surround sound is useful for more than creating dazzling audio effects sequences. Surround sound can open up the listener's sound field to provide an immersive listening environment, even if the soundtrack consists of simple ambience, dialogue, and subtle sound design.

The most common surround sound formats are described below.

- *Dolby Digital (also called AC-3)*: A surround encoding format developed by Dolby Laboratories that contains up to six discrete audio channels. Although typically used to encode every channel of 5.1 surround, it can also be used to encode any subset of these channels. Compressor is capable of encoding any combination of up to five appropriately mixed audio channels plus a sixth LFE channel into a Dolby Digital audio file that you can use for authoring DVD Studio Pro projects. For more information, see the Compressor and DVD Studio Pro documentation.
- *Dolby EX*: Another surround encoding format, designed to accommodate 5.1, 6.1, or 7.1 channels within the same bandwidth. Encoding any channels above 5.1 requires matrixing to fit an additional center channel and/or rear surround channel into the same data space. As a result, the additional channels are not discrete channels, and additional decoding hardware and speakers are required to make use of them.
- *Dolby E*: A surround format that allows up to eight audio channels to be encoded as a digital stream that can be recorded onto an ordinary pair of audio tracks, enabling 5.1 surround mixes to be output to nearly any tape format capable of recording at least 16-bit audio. (6.1 and 7.1 mixes require the tape format to be capable of 20-bit recording.) *Dolby E should not be played without being routed through an encoder.* The encoded digital signal is not intelligible (at least, not to human ears) and may damage your audio equipment. Dolby E requires special equipment for encoding. However, once encoded, Dolby E audio tracks may be output to tape using Final Cut Studio the same as any other pair of audio tracks.
- *Digital Theater System (DTS)*: Another family of digital surround formats that compete with Dolby Digital. DTS requires third-party software for encoding (a Mac OS X-compatible encoder is available from DTS Digital Entertainment). Once encoded, DTS audio files can be imported by DVD Studio Pro (up to 6.1-channel surround sound is compatible) and used for DVD authoring. For more information, see the DVD Studio Pro documentation.

If you're providing a surround mix for your program, there are a variety of ways that distributors may ask for it to be delivered.

- Many broadcasters request that all of your surround channels be output discretely to a digital multitrack tape format. For example, DTRS-format decks are often recommended, including the Tascam DA-88 and DA-98, each of which records eight channels of audio with device controllable timecode that you can synchronize to your master videotape. Typically, a pair of synchronized stereo downmix channels is also output. When you provide the individual surround mix channels, the audio can be encoded into any format necessary.

- If you're delivering your video master on an HDCAM SR or D-5 tape, you may be requested to output all six discrete surround channels, plus stereo downmix channels, onto the tape master itself. HDCAM SR supports 12 audio channels, and D-5 supports 8 channels.
- If you're providing a Dolby E mix, distributors often ask for both stereo and surround mixes output to the same videotape master, because most professional videotape formats support at least four tracks of audio. For example, channels 1 and 2 would contain stereo left and right, and channels 3 and 4 would contain a pair of Dolby E-encoded surround tracks. A properly mixed surround mix can be downmixed easily into a stereo mix.

### Left/Center/Right

This option can serve as a "poor filmmaker's surround mix." With proper mixing, the audible results of using three front channels (left, center, and right) can open up the listener's sound field and provide a more immersive experience than stereo, without the extra work involved in creating a full-blown 5.1 surround mix. Using Compressor, you can easily encode a left/center/right mix into a Dolby Digital audio file for DVD authoring. If the three channels are properly mixed, you can use Final Cut Pro to downmix them into a stereo mix for tape output, using the audio outputs that can be assigned in the Timeline. For more information, see the Final Cut Pro documentation.

### Alternative Audio Mixes for International Distribution

If you're delivering a program for international distribution, there are several standard audio mix deliverables that will probably be requested.

- *Stems and music and effects mixes:* Film distributors often require you to provide *stems*, or dialogue, effects, and music submixes output to separate stereo pairs of tracks. Television broadcasters usually ask for the original mix and a separate music and effects (M & E) mix *without dialogue*. (One exception is that documentary programs often leave the original interview dialogue in an M & E mix but omit voiceover.) For stereo or Dolby E-encoded programs being output to videotape, the original mix is usually recorded to audio tape channels 1 and 2, and the M & E mix is usually recorded to channels 3 and 4. These requests are to accommodate the overdubbing of dialogue into the native language of distribution territories for which dubbing is the norm. Ask the distributor or broadcaster how the various audio tracks should be mixed and organized, as delivery specifications vary.
- *Optional tracks:* Some distributors also request optional tracks, to hold specific aural elements such as nonverbal vocalizations by the original actors that an international sound engineer may or may not want to use. Ask ahead for specific instructions, as delivery specifications vary.

- *Fully filled international tracks*: Often, key production sound effects (for example, a door slamming or footsteps) occur underneath sections of dialogue. If you're asked to provide "fully filled international tracks," that means all sound effects lost when the dialogue tracks are isolated need to be re-created by recording Foley effects and doing additional sound design to "fill in the holes."

Creating stems, M&E mixes, and fully filled international tracks generally involves good organization and some additional sound design. There are two specific features in Soundtrack Pro that can help you facilitate this process.

- *Submixes*: Soundtrack Pro supports routing audio tracks to submixes. It's a common practice to create separate submixes for dialogue, effects, and music, in order to simplify the final mixing process. Fortunately, this also makes it quite easy to output stems and M & E mixes.
- *Ambient noise addition and replacement*: This feature helps you to fill in the "holes" created when you move dialogue into a separate set of tracks, by sampling sections of ambient noise from a scene (sometimes called *room tone*) that can then be used to automatically replace the missing audio. This is usually a first step that precedes additional sound design to place (or *spot*) sound effects and Foley sound over whatever was removed.

For more information about these features, see the Soundtrack Pro documentation.

This chapter covers the following:

- How to Output? (p. 109)
- Doing a Negative Conform (p. 115)
- Long-Term Archiving of the Finished Project and Media (p. 115)

This chapter discusses how to manage the final output and delivery of your program, including the eventual long-term archiving of your program's assets once the project has been concluded.

## How to Output?

You're almost finished with the post-production of your program. After finishing and mastering, all that remains is to output the final master to a format that you can deliver to the client. Final Cut Studio is able to accommodate just about any professional or consumer, video- or film-based format and workflow. For more information, see:

- "Outputting to Tape"
- "Creating Standard Definition DVDs"
- "Creating Blu-ray Discs"
- "Exporting Movies for the Web"
- "Printing to Film"
- "Digital Cinema Mastering"

## Outputting to Tape

Tape output is a requirement for nearly all programs that are going to be broadcast. It's also highly recommended as a safe means of archiving your program in its final, finished state. Distributors and broadcasters typically have specific requirements about which formats they'll accept. These usually include:

- Betacam SP and Digital Betacam for standard definition (SD) programs
- HDCAM, HDCAM SR, and D-5 for high definition (HD) programs

Although these formats are the most common, some networks request masters using other tape formats. Check ahead to see what's required.

The only application in Final Cut Studio that's suitable for outputting to tape is Final Cut Pro. If you're outputting a tape master, there are nearly always strict guidelines about when the program should begin relative to the timecode on the tape, as well as about the type and timing of leader elements that appear before the beginning of your program. For this reason, it's typical to use the Edit to Tape command to perform an insert edit of your program onto a specific section of tape that's been "pre-stripped" (had timecode and black recorded onto the tape in advance).

It's typical for a tape being sent to broadcast to start at 00:58:00:00, with sections of bars and tone, black, a title slate, and more black culminating with the actual beginning of the program starting at 01:00:00:00 exactly. Specifications vary, so check with the distributor in advance before doing your tape output.

For more information about using the Edit to Tape command, see the Final Cut Pro documentation.

*Tip:* Although the Edit to Tape command in Final Cut Pro provides the means to create automated leader elements, many editors prefer to change the sequence timecode to begin at 00:58:00:00 and use color bars, text, and slug generators to build their leader elements right in the Timeline prior to the beginning of the program at 01:00:00:00.

## Creating Standard Definition DVDs

If you need to deliver a standard definition (SD) DVD, you can use DVD Studio Pro to create a DVD project to suit your specific needs. If you just need a simple screening disc for festival play, you can author a DVD that plays as soon as it's inserted. If you're creating a distribution disc that you'll be selling to your audience, you can create a multitemenu experience with your program, including chapter menus, extra features, closed captions and subtitles, commentary tracks, and all the other features audiences have come to expect. After the DVD Studio Pro project is created, you can either burn a disc yourself or deliver the project and media to a facility that's capable of replicating your disc in quantity.

When preparing a program for authoring in DVD Studio Pro, keep the following in mind:

- You can add chapter markers to the Timeline ruler of your sequence in Final Cut Pro in order to place chapter dividers at specific points of your program. These chapter markers are encoded in Compressor or DVD Studio Pro and can be used to automatically create chapter titles in DVD Studio Pro.

- You can encode your program into MPEG-2 media using either Compressor or DVD Studio Pro. If you use Compressor, you have more options for adding closed captioning, making adjustments to the MPEG-2 encoder settings, and adjusting other properties of your program prior to importing it as an asset for your DVD Studio Pro project. The ability to use Compressor with Apple Qmaster for distributed rendering can also speed up the process.
- Using Compressor, you have the option of using third-party MPEG-2 encoding components, if they're installed on your system.
- You can use Compressor to encode Dolby Digital surround sound media for your DVD Studio Pro project.

Instead of using DVD Studio Pro, you can use the Share command in Final Cut Pro and Motion to quickly create and burn a simple DVD to hand off for screening. The Share window provides options for creating a simple play menu, adding a title graphic, and using any chapter markers in the Timeline to create subtitles with which to identify different parts of the video. For more information about using the Share command, see the Final Cut Pro documentation.

### Creating Blu-ray Discs

You can use the Share command in Final Cut Pro and Motion, or the batch template feature in Compressor, to create and burn a simple Blu-ray disc. You have the following options:

- Choose whether the disc plays immediately or displays a play menu.
- Choose a template for the menu.
- Choose a title graphic, logo for superimposition, and background graphic.

You need to use a third-party Blu-ray burner to create Blu-ray discs. However, if you don't have a Blu-ray burner, you also have the option of creating an AVCHD disc by choosing your SuperDrive (or any standard DVD burner) as the output device. AVCHD discs can be played on a subset of Blu-ray players that are specifically compatible with the AVCHD disc format.

**Note:** DVD Studio Pro cannot author or create Blu-ray discs. However, you can use Compressor to encode an H.264 movie for Blu-ray authoring in a third-party application such as Adobe Encore.

### Exporting Movies for the Web

If you're preparing your program for web delivery, Compressor lets you create high-quality, multipass videos in the popular H.264 format. In addition, you can use third-party QuickTime components to add the ability to compress to other formats, if necessary.

Compressor can work with an Apple Qmaster cluster to use multiple processing cores on a single computer and multiple computers on a network to process a single batch of media files. This can speed up your compression workflow substantially. For more information about setting up a cluster for distributed processing, see the *Distributed Processing Setup Guide*, available in Compressor Help or Apple Qmaster Help.

You can send an edited program or QuickTime movie to Compressor in one of two ways:

- Using the Share command in Final Cut Pro or Motion
- Exporting a QuickTime movie (either self-contained or reference) from any application and adding it to Compressor manually

When one or more media files are queued up, Compressor takes the following steps to prepare your program for the web:

- Changing the frame rate, removing 3:2 pull-down, and deinterlacing programs for optimal onscreen web playback
- Applying video filters for color adjustments, noise removal and sharpening, and watermarking
- Resizing and cropping the frame dimensions as appropriate for your presentation and bandwidth requirements

There are a variety of presets available in the Settings window that are appropriate for creating web media. You can use these settings as they are or customize them for your own particular needs.

To make web sharing even easier, Compressor also has built-in templates (similar to the Sharing options found in other Final Cut Studio applications) for publishing compressed H.264 media files to MobileMe and YouTube for automated video hosting. The Publish to MobileMe and Publish to YouTube templates have post-transcoding actions that facilitate automatic uploading, as long as you already have accounts set up.

A third template, called Create Web Reference Movie, automatically creates three compressed versions of your program for the web (small, medium, and large), along with an accompanying reference movie that's linked to each version. Whenever a viewer goes to a webpage that contains the embedded reference movie, the appropriately sized movie for a given device and connection speed is displayed automatically.

For more information about creating movies for the web, see the Compressor documentation.



## Printing to Film

In any digital intermediate (DI) workflow involving Final Cut Studio, the final deliverable is typically a single, continuous DPX image sequence of your entire program. Because it's an uncompressed RGB 4:4:4 format that's capable of containing 10-bit log data, DPX is usually the preferred data format for delivering image sequences for film printing.

Unlike workflows in which a Color project is sent back to Final Cut Pro for output, you use Color to render the final deliverable image sequence, collating it for film output using the Gather Rendered Media command.

If you're outputting an image sequence from Color for printing to film, here are some things to remember.

### Render incompatible effects as self-contained QuickTime movies before sending to Color

Because Color is rendering the final media, you need to make sure that every clip you send to Color is in a compatible format or uses compatible effects. Effects that aren't compatible with Color for purposes of rendering film output include:

- Filters
- Generators
- Embedded Motion projects
- Certain Final Cut Pro Motion tab settings, including Crop, Distort, Opacity, Drop Shadow, and Motion Blur
- All keyframes applied to Motion tab settings in Final Cut Pro
- Superimposed clips using opacity or composite modes

You need to export every clip in your Final Cut Pro project that uses an effect that isn't compatible with Color as a self-contained QuickTime file. You then reedit these exported QuickTime files into the Timeline of your sequence to replace the original effects *before* you send your sequence to Color.

**Note:** If your program requires effects work such as titles and superimpositions, these may be created as self-contained QuickTime movies and edited into your program either before you send it to Color, or after you export your final image sequence from Color using a compositing application that can import and output DPX image sequences. If you insert effects after the final render, make sure to carefully maintain the frame naming and numbering of each shot you process.

### **Render speed effects as self-contained QuickTime movies before sending to Color**

Although speed effects are compatible with Final Cut Pro–to–Color roundtrips, they should be exported as self-contained clips and reedited into your Timeline to replace the original effects, as described in the previous section. If you’re preprocessing slow-motion clips, you’ll achieve a better result by sending these clips to Motion and rendering them using the optical flow analysis features in Motion. For more information, see “Creating High-Quality Slow-Motion Clips Using Motion.”

### **Make sure that cross dissolves are the only transitions you use**

When you render 2K or 4K DPX or Cineon image sequences, all video transitions are rendered as linear dissolves when you use the Gather Rendered Media command to consolidate the final rendered frames of your project in preparation for film output. This feature is intended to support only film output workflows. Any other type of transition (such as a wipe or iris) is rendered as a dissolve instead, so it’s a good idea to go through your project and change the type and timing of your transitions as necessary *before* sending your project to Color.

### **Create any animated pan and scan effects in Color**

When you render DPX or Cineon image sequences, all the transformations made using the Geometry room’s Pan & Scan tab are rendered and output. This includes effects that were keyframed in Color.

### **Make Sure to Check the Color Documentation**

Digital intermediate workflows can be complicated. Make sure you read the Color documentation for more information about Color workflows, including how to organize scanned film material and native RED QuickTime media, how to prepare Final Cut Pro projects for sending to Color, and how to render media that’s appropriate for film printing.

### **Digital Cinema Mastering**

The process of creating a digital cinema master is similar to film printing, in that you typically render a DPX image sequence as your final deliverable. However, you usually send the consolidated image sequence that Color produces to a facility that’s set up to encode and encrypt your program to the exacting standards required to create a digital cinema distribution master.

For more information about outputting an appropriate DPX image sequence, see “Printing to Film.”

## Doing a Negative Conform

If you're finishing a film program by conforming the original negative, in advance of doing optical color timing and film printing, you should have started out by importing a telecine log file into Final Cut Pro (or into Cinema Tools). The telecine log file contains the data necessary to maintain the correspondence between the edge code from the original camera negative and the timecode used by the telecined video clips that you've been editing. It's also common practice to put a window burn of the edge code and timecode at the bottom of every transferred shot, to provide an additional visual reference.

When you finish your edit, you can use this film data to output a negative conform list from Final Cut Pro. Before doing so, it's best to go through your sequence to make sure everything is as organized as possible for the generation of a clean film list. The following steps will help you reorganize your edited sequence for a clean negative conform:

- Turn on Show Through Edits in the Timeline in Final Cut Pro, and use the Join Through Edit command to eliminate all unnecessary through edits to avoid accidental cuts to the negative.
- Make sure all clips that aren't supposed to be superimposed are moved to track V1. (You can export only one track at a time as a film list.)
- Check in advance to see if there are any length or type restrictions for transitions, and make adjustments as necessary.
- Use the Show Duplicate Frames option in the Timeline to make sure that you're aware of duplicated clips that may necessitate additional optical printing.

For more information about negative conform workflows, see the Cinema Tools and Final Cut Pro documentation.

## Long-Term Archiving of the Finished Project and Media

After you create your final master and other necessary deliverables, the last step is to archive your program. When preparing to archive your program, you need to gather every Final Cut Pro, Motion, Color, and DVD Studio Pro project file and every source media file, font, still-image file, QuickTime clip, and final rendered output file. In short, make sure that you archive everything that would be necessary to re-create your project five years in the future, should the need arise.

- *If you've been using Final Cut Server:* Chances are that your project files and media are already organized and ready to be archived. In this case, mount the volume you want to archive your program's assets to, and then use the Archive To command to write all files to the archive device. When you later need to retrieve your assets, you can use the Restore command. For more information, see the Final Cut Server documentation.

- *If you're not using Final Cut Server:* In this case, you need to gather all of your program's assets manually. It's usually best to move everything to a particular set of volumes in preparation for archiving, but the most efficient way to do this depends on the amount of hard disk space you have and how your media is organized.

When deciding how to archive your program and its media, you have two choices.

- *Archiving to hard disks:* Copying all of your program's assets to a hard disk can be a fast and economical solution and is an excellent way to back up your assets in the short term. A particular advantage to hard disk backups is the ease with which you can retrieve assets.

However, hard disk backups may not always be the best long-term solution. The data on hard disks stored for a year or more without being started up can begin to become unreliable. Periodically starting up each archive disk and reading all of the data on the disk can prevent this problem, but this approach requires diligence. Also, disks are physical mechanisms, and there's always the chance of mechanical failure. Using a pair of mirrored hard disks for your backups provides additional insurance against losing valuable data to disk failure.

If you need to archive your project for longer periods of time, there's another choice.

- *Archiving to tape:* Many facilities archive their project assets to Linear Tape-Open (LTO) tape. LTO drives store data on tape cartridges that, when properly stored, are considered to have a lifetime of 15 to 30 years. It's common practice to create two tapes for an additional level of safety, and the result is an extremely reliable long-term backup solution.

There have been several generations of LTO tape technology available from several manufacturers. The current standard is LTO-4, with a maximum uncompressed capacity of 800 GB per tape. In Mac OS X, LTO tape drives can be written to using third-party utilities, and they're also compatible with Final Cut Server.

**Tip:** However you decide to back up your media, for the greatest level of safety, it's ideal to have two sets of backups, including one that's stored offsite in a secure location in case of fire, theft, or natural disaster.