

Sorenson Video[®] 3

Version 3.1—User Guide

***sorenson*media**

Enter your serial number (from the back of your CD case) in the space below.

Serial Number: _____

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One or more of the features described in this manual are claimed by one or more of the following US patents:

US Patent Nos. 5,031,037; 5,124,791; 5,799,110; 5,844,612; 5,398,069

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Introduction and Installation

The Sorenson Video® 3 codec is the result of over ten years of intensive research and development. The evidence of this investment is seen in the unparalleled combination of compression and quality. As an integral part of Apple's QuickTime™ technology—beginning with QuickTime 3—Sorenson Video has delivered high quality compressed video across multiple computer platforms and the Internet.

Standard vs. Professional

Two versions of the Sorenson Video 3 codec are available: the Standard Edition and the Professional Edition.

The Sorenson Video Standard Edition codec is included as part of Apple's QuickTime 5. The Standard Edition has the basic compression controls for data rate, frame rate, and fixed keyframe intervals. In addition, some of the advanced features are applied to compression with default settings, which you cannot modify. The Standard Edition codec produces good results for average video content at moderate data rates (50 KB or above).

The Sorenson Video Professional Edition codec adds additional control to the compression process for the serious multimedia content producers. The professional features include:

- ◆ Data rate tracking for superior quality at low bit rates
- ◆ Automatic keyframe sensitivity control

- ◆ Bidirectional prediction
- ◆ Video watermarks
- ◆ QuickTime streaming support
- ◆ Video masking

For a complete list and explanation of all features, see the Sorenson Video 3 Feature Reference starting on page 30.

Using the Professional Edition features, you can produce high quality video even at very low data rates. The Professional Edition has the fine control necessary to handle all types of video, from interviews to sports footage.

Sorenson Video 3 features

Sorenson Video 3 contains a number of exciting features and improvements, including:

- ◆ Optimized for Macintosh G4, MMX, and SSE
- ◆ Image smoothing
- ◆ Fixed quality option
- ◆ Full-color video watermarking
- ◆ QuickTime 5 streaming support
- ◆ Bidirectional frames
- ◆ Video masking
- ◆ Media key encryption
- ◆ Variable Bit Rate (Two-Pass and One-Pass)
- ◆ Multiple processor support

Installation

The Sorenson Video 3 Professional Edition codec is available for the Apple Power Macintosh and for Windows 9x, 2000, and NT systems. Prior to installing your codec, be sure your install CD is the correct one for your operating system. If you have the wrong CD, contact your software supplier or our Technical Support department at support@sorenson.com. Make sure your computer meets or exceeds the system requirements listed below.

System requirements

Compressor. The Sorenson Video compressor on this CD requires a QuickTime 4.0 or later development environment. Current development platforms include:

- ◆ Power Macintosh™ (OS 8.6 or later, including OS X)
- ◆ Microsoft™ Windows™ 9x, 2000, XP, and NT™

Playback. Current playback platforms include:

- ◆ Power Macintosh
- ◆ Macintosh G3 and G4
- ◆ Microsoft Windows 9x, 2000, and NT

- *Note: All playback platforms must have QuickTime 5 or later installed.*

Macintosh installation

To install the Sorenson Video 3 codec on a Macintosh:

1. **Insert the Sorenson Video 3 CD in your CD-ROM drive.**
2. **Double-click the Sorenson Video CD icon.**
3. **Double-click the Install Sorenson Video icon to start the installer.**
4. **Follow the install wizard to complete the installation.**

Installation

Windows 9x/2000/NT installation

To install the Sorenson Video 3 codec on Windows 9x/2000/NT:

1. **Insert the Sorenson Video 3 CD in your CD-ROM drive.**
2. **From the Start menu, select Run.**
3. **In the Run dialog box, enter the following command:**
D:\Setup
(Where D: is the drive letter for your CD-ROM drive.)
4. **Follow the install wizard to complete the installation.**

Check your installation

A quick way to validate a successful installation is to use Apple's QuickTime Player Pro. Using QuickTime Player, load a movie file and then set the export video options to Sorenson Video 3. With a successful installation, the Sorenson Video 3 Options button displays the full advanced features dialog box.

- *Note: This procedure requires QuickTime Player Pro in order to use the movie export features.*

Following are the complete instructions to test your installation:

1. **Open an uncompressed movie file in Apple's QuickTime Player Pro.**
2. **From the file menu, select Export.**

The Export dialog box appears. At the bottom left of the Export dialog box is a drop-down list of output formats.

3. **In the Export dialog box, set the output format to "Movie to QuickTime Movie."**
4. **Click Options to display the Movie Settings dialog box.**
5. **From the Video section, click Settings to display the Compression Settings dialog box.**

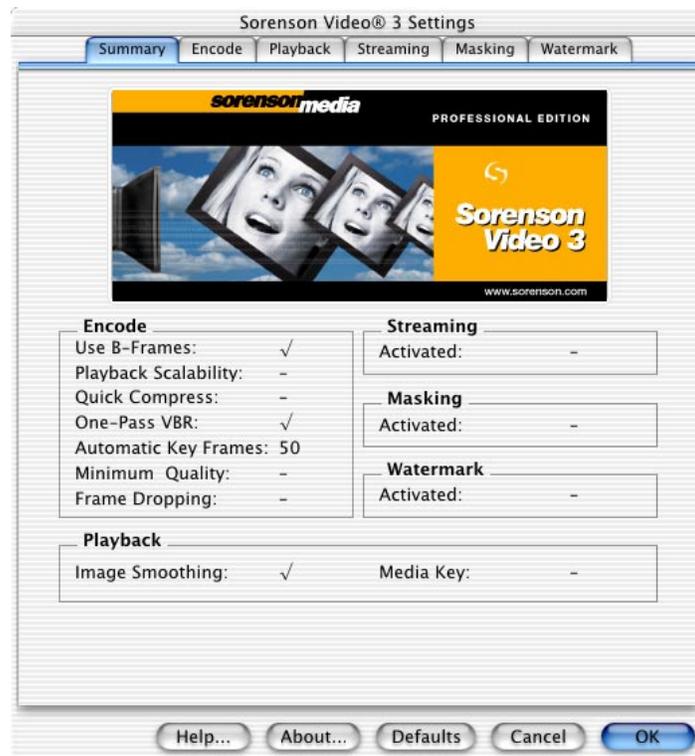
The top selection list of the Compression Settings dialog box contains a list of video compression codecs.

6. From the codec drop-down list, select Sorenson Video 3.

When you select Sorenson Video 3, an Options button appears at the bottom left corner of the Compression Settings dialog.

7. Click the Options button to display the Sorenson Video 3 Settings dialog box.

If you have successfully installed the Sorenson Video 3 Professional Edition, the Sorenson Video 3 Settings dialog box appears.



Installation

If the Sorenson Video 3 dialog box appears, the installation was successful. If you still have the Standard Edition of the Sorenson Video Settings dialog box, try the installation again. If the problem persists, contact the Sorenson Media Technical Support at:

Email: support@sorenson.com

Web site: www.sorenson.com

Now that Sorenson Video 3 is installed, you are ready to compress video. If you are new to multimedia production and video compression as a part of the production process, read through “Multimedia production process” on page 67 for an overview on producing multimedia. For those that want to jump in, make sure you read “Understanding compression” on page 10 and “How Sorenson Video works” on page 12 to help you understand how to use the Sorenson Video 3 codec more effectively.

For those who are familiar with Sorenson Video and how to use it, go to the “Sorenson Video 3 Feature Reference” on page 29 for an explanation of the Sorenson Video 3 features.

Sorenson Video Compression

There are many different video codecs available today and each codec is a little different. Sorenson Video is a QuickTime codec, which means that it works within Apple's QuickTime multimedia architecture. The Sorenson Video 3 decoder (and a standard encoder) is built right into QuickTime 5. All you need to play Sorenson Video 3 compressed movies is Apple's QuickTime 5. With the decoder built into QuickTime, it is very simple to distribute Sorenson Video movies for playback on a wide variety of computers.

After you capture your video footage, the first step to delivering Sorenson Video movies is to compress the video. In order to compress properly, it is important to understand how Sorenson Video works. This section explains some basic compression concepts and how they relate to Sorenson Video.

Understanding compression

Compression is like making orange juice concentrate. Fresh oranges go in one end and concentrate comes out the other. The concentrated orange juice takes up less space, is easier to distribute, and can be easily reconstituted by the consumer.

Likewise, video compression takes a large file and makes it smaller. The smaller files require less hard disk space, less memory to run, and less bandwidth to play over networks or the Internet. Many compression schemes exist and all have their specific strengths and weaknesses.

Lossless vs. Lossy compression

There are two types of compression: lossless and lossy.

Lossless

Lossless compression preserves all the data, but makes it more compact. The movie that comes out is exactly the same quality as what went in. Lossless compression produces very high quality digital audio or video, but requires a lot of data. The drawback with lossless compression is that it is inefficient when trying to maximize storage space or network and Internet delivery capacity (bandwidth).

Lossy

Lossy compression eliminates some of the data. Most images and sounds have more details than the eye and ear can discern. By eliminating some of these details, lossy compression can achieve smaller files than lossless compression. However, as the files get smaller, the reduction in quality can become noticeable. The smaller file sizes make lossy compression ideal for placing video on a CD-ROM or delivering video over a network or the Internet. Sorenson Video is a lossy codec, as are most codecs in use today.

Spatial and Temporal compression

There are two different ways to compress digital media: spatial and temporal.

Spatial compression

Spatial refers to compression applied to a single frame of data. The frame is compressed independently of any surrounding frames. Compression can be lossless or lossy. A spatially compressed frame is often referred to as an “intraframe.”

Temporal compression

Temporal compression identifies the differences between frames and stores only those differences. Unchanged areas are simply repeated from the previous frame(s). A temporally compressed frame is often referred to as an “interframe.”

How Sorenson Video works

The Sorenson Video codec has significantly increased the digital video capabilities of Apple's QuickTime architecture. However, in order to achieve good results, you need to understand how the codec works.

Interframe vs. Intraframe

Compressed video frames are defined as interframes or intraframes.

Interframes

Sorenson Video is categorized as an "interframe" codec. Interframe means many frames are described based on their difference from the preceding frame. Sorenson Video's efficient interframe compression is part of what separates it from other compression technologies, requiring a much lower data rate than most other codecs to produce good quality video. For specific data rate guidelines, see "Limit data rate to" on page 33.

Intraframes

"Intraframe" codecs compress each frame separately and independent of surrounding frames (JPEG is an intraframe codec). However, interframe codecs also use intraframes. The intraframes are used as the reference frames (keyframes) for the interframes.

Sorenson Video always begins with a keyframe. Each keyframe becomes the main reference frame for the following interframes. Whenever the next frame is significantly different from the previous frame, the codec compresses a new keyframe. For a more thorough discussion of keyframes, see "Keyframe every" on page 32.

Color

Another way Sorenson Video saves storage space is through color space reduction. The human eye is much more sensitive to brightness (luminance) than to color (chrominance). Sorenson Video takes advantage of this by storing color information in 2x2 blocks. These 2x2 blocks of color are known as YUV-12 colorspace and are commonly used in other codecs as well.

YUV-12 saves space by storing less color information. For each 2x2 block of data, YUV-12 stores 4 luminance samples (Y), one for each pixel, but only two chrominance (U, V) samples. This greatly reduces the amount of information needed to reconstruct the image, providing a much higher compression ratio.

YUV-12 is a great way to save space, and in most instances the reduced color information is invisible to the eye. The color subsampling is independent of the compression level and is always reduced to 2x2 blocks.

- ▶ *Note: Since Sorenson Video divides an image into 16x16 pixel blocks, the codec is most efficient when the frame size is an even multiple of 16. If the frame size is not an even multiple of 16, the codec simply pads the odd vectors with empty pixels to force a full 16x16 pattern. The empty pixels are then removed on playback to reconstruct the image at the original dimensions.*

Asymmetric

Some codecs are fairly symmetrical in that it takes a similar amount of time to decode as it does to encode. Sorenson Video is asymmetrical. It takes more time on the encode side in order to keep it as simple as possible on the decode side.

In most situations, encoding is not done in “real time.” Depending on the size, frame rate, and data rate of your video, and the speed of your computer, Sorenson Video may take quite a while to encode, but decoding is in real time. For more specific information, see “Encode performance considerations” on page 20 and “Playback considerations” on page 21.

Video compression guidelines

The key to achieving great compression results is understanding the codec and how the options effect the finished output. This section discusses the options and decisions that determine how video is compressed when using Sorenson Video.

As with any tool, there are some basic guidelines that will help you get the most from your Sorenson Video 3 codec. This section starts off with some general guidelines that apply to all types of video and then discusses compression of several specific types of video. For a complete feature description, see “Sorenson Video 3 Feature Reference” on page 29.

General considerations

As you prepare to compress a video clip, there are several factors that have a significant effect on your compression configuration. The method you plan to use for delivering the video influences many of the options available to you. In addition to the delivery mechanism, you must also consider your playback audience. What type of systems do they have and how are they going to receive the video? All of these factors influence one of your first compression choices, the compressed data rate.

Data rate

The data rate should maximize the video quality for the targeted delivery channel. For example, if you are delivering video from CD-ROM, the data rate can range anywhere from 200 KB/second or less. However, if you are delivering video over the Internet, the data rate can range anywhere from 1.5 KB/second to as high as 50 KB/second, depending on the connection speed of your target audience.

One of the most common mistakes with new users is setting a data rate that is too high. Generally, quality improves as data rate increases, and the more movement in the clip, the higher the data rate must be to maintain the quality. However, Sorenson Video does have a "quality ceiling." Beyond a certain data rate, the clip looks almost uncompressed and the quality doesn't get any better. Fortunately, Sorenson Video's "quality ceiling" is reached with a much lower data rate than many other codecs.

For example, a clip that requires 350 KB/sec with Cinepak™ may only need 100 KB/second or less with Sorenson Video.

As a starting point, use the following formula to establish your compression range with Sorenson Video.

$$\text{Datarate} = \frac{\text{Width} \times \text{Height} \times \text{FPS}}{48000}$$

Depending on your video type, Sorenson Video looks good and performs well when the data rate is greater than 1/2 and less than double the result of the data rate formula. For example, a 320x240 30 fps clip yields the following results:

$$\text{Datarate} = \frac{320 \times 240 \times 30}{48000} = 48\text{KB/s}$$

48 KB/sec is the general target data rate for a 320x240, 30fps clip.

A talking head clip with little motion could compress well as low as 24KB (about 1/2). However, a sports action clip may need as much as 96 KB/sec (double) or higher to look good.

- ▶ *Note: High action clips may require a data rate above the 96 KB/s target for a standard 320x240 clip. However, the higher data rate may make playback difficult on lower-end machines. Be sure to test all compressed video on your target playback platforms.*

The target data rate formula discussed above gives you a starting point. The actual data rate you use depends largely on the video content and the target playback platforms. Use the formula as a guide and try several data rates within the range, testing them for clarity and playback on your target platforms. If you need to improve the image quality at your target data rate (without increasing the data rate), try reducing the frame rate or using a smaller frame size.

Delivery mechanism

An important part of compressing your video is knowing how the final product will be distributed. The distribution channel often places restrictions on the video compression. For example, if you plan on delivering the finished video across the Internet, you need to take into account the different download speeds and options.

Multimedia video has two common delivery channels:

- ◆ CD-ROM

General considerations

- ◆ Internet/Intranet

CD-ROM

CD-ROM delivery carries the least possible restrictions. A standard CD-ROM will transfer a faster data rate than you would normally use with Sorenson Video (see the data rate discussion earlier in this chapter).

With CD-ROM delivery, you balance the size and quality of the video with the amount of video you want to deliver. Large video at higher data rates takes up more space. Smaller video and/or lower data rates lets you put more minutes of video on the CD. Table 1 shows how much video you can put on a CD at various data rates.

Table 1: CD-ROM video capacity at various data rates.

Data rate (KB/s)	Minutes/CD
180 KB/s	63 minutes
90 KB/s	124 minutes
75 KB/s	149 minutes
60 KB/s	186 minutes
30 KB/s	372 minutes

Internet/Intranet

The main restrictions of Internet/intranet delivery are based on the available bandwidth of your network. For example, if you are delivering video over the public Internet, many people in your target audience are still using 56k modems. However, if you are delivering video over a company intranet, the connection rate is usually much higher (since you are generally running over the company network).

The key to selecting the correct data rate is to know your audience. Once you define your audience, you have three main options:

- 1 Create all video at 56K dialup rates (approximately 4 KB/s video plus audio).
- 2 Create the video at higher data rates and assume that users with slower connections will have the patience to download the video. (Many business users have network connections to the Internet and are not limited by slow modem speeds.) This option also works well for intranets where most users are using the company network to access the information.
- 3 Use QuickTime's Movie Alternates features. Using Movie Alternates, you can create a movie for the three main data rate categories (dialup, ISDN, and T1 network). When the user requests the movie, QuickTime automatically selects the appropriate movie for the user's connection rate. This is a very good option when you can't control the connection rate of your users.

If you compress at a higher data rate and don't want to use Movie Alternates, keep your clips short so that the maximum download time is not too burdensome for your audience. It is always best to experiment and make sure the performance is what you expect.

Once you select your data rate, you have two delivery options, HTTP and RTSP. Both methods are considered "streaming" technologies (the video plays as it downloads). However, while both types may appear very similar to the user, there are some significant differences.

HTTP. HTTP delivery is when you place a compressed QuickTime video on a web page. When a user visits the web page and selects the video link, the video plays. There are several advantages to HTTP delivery:

- ◆ Uses standard web server and pages.
- ◆ Guaranteed video quality.
- ◆ No firewall problems.

General considerations

RTSP. RTSP delivery also has links on a standard web page, but the video files themselves must reside on a special server, not the standard web server. RTSP can also be used to deliver stored video files much like HTTP streaming or it can be used for live broadcasts. However, RTSP delivery has several significant differences from HTTP delivery.

- ◆ Requires a special media broadcast server.
- ◆ No guaranteed quality.
- ◆ Firewall issues (some firewalls block this type of streaming)
- ◆ Capable of streaming live events.
- ◆ Very long streams (file is not stored on local computer).
- ◆ Property protection (since the video is not stored anywhere by the end user).
- ◆ Capable of random access.

For a more detailed description of QuickTime streaming options with Sorenson Video, see “Streaming Media” on page 55.

Encode performance considerations

As mentioned earlier, Sorenson Video takes longer to encode than to decode (it is asymmetrical). The main consideration in compression time is the amount of data the codec has to analyze. Table 2 shows average frame rates achieved compressing moderate motion clips on a Macintosh G4-450 with the fixed quality set at 50.

Table 2: Sample compression rates on a Macintosh G4-450

Frame size	Average frame rate achieved
320x240	15 fps
160x120	35 fps

As you change the amount of data processed, the compression time should match the change. For example, a 160x120x15fps movie is 1/4 the size of the 320x240x15 clip. The compression time would also be about 1/4. If you increase your frame size, or frame rate, the compression time increases.

If you want to encode faster, you have several options:

- ◆ Reduce the frame size.
- ◆ Reduce the frame rate.
- ◆ Change your Encode Rate option. *For more information, see "Quick Compress" on page 37.*

If you use the Variable Bit Rate (VBR) options with Terran Interactive® Cleaner 5™, the compression rate is roughly twice as long. VBR actually analyzes the video clip prior to compressing it, requiring two passes through the clip. The results are significantly better, but it also takes more time.

On a much smaller scale, the complexity of the video and the target data rate do affect the amount of time required to encode. However, the differences are much less noticeable than with different frame sizes and frame rates.

Playback considerations

Playback is generally only an issue with CD-ROM distribution. A CD-ROM handles data rates much higher than Sorenson Video needs (see the data rate section). In general, if you use the target data rate formula, you should find acceptable playback on most systems.

If you are targeting lower end Pentiums and Power PCs, you normally see good performance at 320x240x15 at 70KB/s or less. Smaller frame sizes and lower data rates increase your playback range while larger frame sizes or higher data rates may require faster processors to play. Video targeted for Internet and network distribution is not normally a problem since the data rates are usually below 70 KB/s.

General considerations

The key here is the same as when selecting your data rate: know your audience. If your target playback audience has more powerful computers, you can safely use higher data rates. If you are targeting more universal playback, you should stay below the 70 KB/s line or consider some of the options below.

Video doubling

To maintain playback capability on these lower-end machines, we don't recommend compressing video at full-screen (640x480). If you need full-screen display, one option is to use QuickTime's doubling feature.

One of Sorenson Video's great features is the ability to scale in "doubled" mode and still look good. When scaling by 2, most codecs simply fill each 2x2 block with the value that would originally have come from a single pixel. Sorenson Video takes advantage of a QuickTime conversion mode that provides a smooth scaling algorithm (bicubic for those familiar with Adobe® Photoshop®) that looks much better. Using QuickTime's doubling feature is a great way to play 640x480 Sorenson Video movies without the large data rate overhead of a 640x480 movie.

Pixel doubling is also very useful for web movies, where a frequent complaint is the small size. Double a 160x120 web movie and suddenly you have 1/4 screen video played over the Internet, without lengthy download times. With very low data rates, reducing the native frame size and then doubling the movie often yields better quality than extreme compression.

To save a movie to automatically play back doubled:

- 1. Open the movie in QuickTime Player.**
- 2. From the Movie menu, choose Double Size.**
- 3. From the File menu, choose Save.**

Now, each time you open the movie, it automatically displays doubled.

- ▶ *Note: If you are using Cleaner 5 to compress your video, setting the movie to play back doubled is even easier. Just select "Playback Doubled" from the Image tab before compressing your movie.*

Doubling the video can still place a strain on some older computers. The difficulty is caused by older graphics cards that lack hardware acceleration. Machines without hardware accelerated video cards may have trouble displaying doubled video simply because they can't send the data to the screen fast enough.

CPU alternates

QuickTime 4 introduced a new option to the Movie Alternates feature: CPU alternates. Using the CPU alternates option, you can create several versions of a movie at different data rates and frame sizes, specifying each version for a CPU range.

The CPU alternates option allows you to produce great-looking video for today's more powerful computers, but still provide a scaled-down version for the older installed base. The alternate video can still look great, however, it will be smaller, have a lower data rate, or some other variation to enable playback on less powerful computers.

Playback Scalability

Another option for increasing the playback range with low-end computers is to use Sorenson Video's playback scalability option. When you select the scalability option during compression, the clip is configured to drop frames evenly for computers that can't keep up.

For example, if you create a 320x240x30 fps movie clip at 70 KB/s, some slower computers may not be able to decode the clip at the full frame rate. Without playback scalability, the computer simply stops decoding video until the next key frame (then the audio continues). This makes for very "jerky" playback.

General considerations

However, if you encode the video with playback scalability turned on, the decoder sees that option and automatically drops every other frame, decoding at 15 fps instead of 30 (1/2 the encoded frame rate). The quality of the movie is the same as if it had been encoded at 15 fps instead of 30 fps and the user experiences smooth playback.

Summary

In summary, as you prepare video for distribution you should be aware of the following playback considerations and options:

- ◆ Data rate—70 KB/s or less if you require playback on lower-end machines
- ◆ Frame size—320x240 or less recommended for all machines
- ◆ Frame rate—15 fps or less for low end machines
- ◆ Doubling—a great way to display full-screen, but is dependent on the computer graphics cards (may have trouble on older machines)
- ◆ CPU alternates—a great way to extend your playback range with lower-end computers while still providing higher data rate or larger clips for today's more powerful computers.
- ◆ Playback scalability—an encoder option that lets the decoder smoothly drop every other frame for smooth playback on slower computers.

Content considerations

How you compress your video is largely determined by the content of the video. A video clip of a talking head with very little action and only short bursts of moderate motion compresses very differently than footage of a soccer match.

The following charts provide general guidelines for achieving good compression results using the Sorenson Video 3 codec. These guidelines are only intended as a starting point. Each video clip has distinct characteristics. The optimal compression parameters vary based on the content of the clip and your intended delivery method. *For a complete explanation of the Sorenson Video compression options, see "Sorenson Video 3 Feature Reference" on page 29.*

Training video

Training video usually consists of interviews, presentations, training materials, and other business communications. In general, training videos are mostly low motion with short sections of moderate action.

Training video usually compresses very well at lower data rates. The lower levels of action and motion require less data, thus allowing training video to compress well for most delivery mediums, including the Internet. The following guidelines are only suggested starting points. The optimal compression settings depend on the video content, compression level, and finished frame size.

Compress for CD-ROM and LAN. When you compress for CD-ROM and/or high-bandwidth network distribution, you can compress with a higher data rate. The higher data rate allows you to use larger frame sizes with greater clarity and detail in the final compressed video.

Content considerations

The following parameters give you a good range for compressing training video for CD-ROM and high-bandwidth network delivery.

Frame size:	320x240
Frame rate:	15-30
Data rate:	40-70 KB/s (for maximum playback range)
Key frame every:	300
Automatic key frames:	50
Quick compress:	Optional
Playback scalability:	Off

Compress for the Internet. In general, the lower data rate requirements of training video make it a good candidate for Internet delivery. The data rates used for Internet delivery can vary widely, depending on your target audience. *For more information, see "Delivery mechanism" on page 17.* The following parameters give you a good range for compressing training video for Internet delivery.

Frame size:	Dialup: 240x180 or smaller ISDN/T1: 320x240
Frame rate:	Dialup: 4-15 ISDN/T1: 15
Data rate:	Dialup: 1.5-5 KB/s ISDN/T1: 12-50 KB/s depending on content and frame size
Key frame every:	300
Automatic key frames:	50
Quick compress:	Off
Playback scalability:	Off

Sports video

The high motion content of sports footage requires higher data rates to maintain clarity and detail. The higher data rate requirements also make it much more difficult to deliver these clips on the Internet. At dialup data rates (1.5-2 KB/s) much of the detail is lost in the continuous motion. However, you can still achieve good quality at CD-ROM, intranet, and network rates.

Compress for CD-ROM and LAN. When you compress for CD-ROM and/or high-bandwidth network distribution, you can compress with a higher data rate. The higher data rate allows you to use larger frame sizes with greater clarity and detail in the final compressed video. The following settings give you a good range for compressing sports and action video for CD-ROM and LAN delivery.

Frame size:	320x240 or smaller
Frame rate:	15-30
Data rate:	70-150 KB/s
Key frame every:	300
Automatic key frames:	50
Quick compress:	Off
Playback scalability:	On

Compress for the Internet. If you need to deliver sports and action clips over the Internet, you should produce files at lower intranet data rates. Users with fast Internet connections can view the files with little or no wait, but dialup users will just have to wait for the files to download. In these situations, it is best to make the clips short to keep the download times within acceptable limits for dialup users.

Content considerations

The following parameters give you a good range for compressing sports and action video for Internet delivery.

Frame size:	Dialup: 160x120 ISDN/T1: 240x180 or smaller
Frame rate:	Dialup: 8-15 ISDN/T1: 15 (1/2 native frame rate)
Data rate:	Dialup: 20-40 KB/s ISDN/T1: 30-70 KB/s depending on content and frame size
Key frame every:	300
Automatic key frames:	50
Quick compress:	Off
Playback scalability:	Off

Sorenson Video 3 Feature Reference

Sorenson Video 3 features are categorized in two groups, standard and professional. The standard features are available in the Standard Edition of the Sorenson Video encoder that is included in Apple's QuickTime 5 software. With the Standard Edition, the professional features are set at default values or disabled.

To have access to the professional features, you must purchase the Sorenson Video 3 Professional Edition encoder. With the Professional Edition, you have access to all the professional features as well as the standard features for complete control of the Sorenson Video 3 codec. The feature sets are explained in the following sections.

Standard features

The Sorenson Video standard features are available in all versions of the Sorenson Video 3 codec. The basic compression options are:

- ◆ Quality
- ◆ Frames per second
- ◆ Keyframe every
- ◆ Limit data rate to

The following Professional features are enabled and set at default values.

- ◆ Automatic Key Frames—set at Medium Sensitivity
- ◆ Minimum Quality—set at 0
- ◆ Frame Dropping—turned On
- ◆ Image Smoothing—turned On

For more information on the Professional features refer to “Professional features” on page 36.

Quality

The Quality setting gives the codec a target for visual quality for each frame. The quality setting has a range of “Least” to “Best” with the following results:

- ◆ 100—lossless (or virtually lossless)
- ◆ 80—visually lossless
- ◆ 60—setting used for movie trailers (almost no visible noise)
- ◆ 40—with postfilter, good quality
- ◆ 35 and below—low quality

When you compress with a quality target, you need to turn off all data rate settings.

- ▶ *Note: The Quality setting is ignored when you specify a data rate limitation.*

The data rate fluctuates, frame by frame, to meet the quality target and the compressed clips may have occasional bursts of very high data rates (spikes) that could disrupt playback on low-end machines. Fixed quality compression gives best possible quality like VBR, but you can't predict the overall data rate of the clip.

Frames per second

The Frames per second setting indicates how many frames (individual pictures of the movie) are played each second. If you leave the box blank or select "Best", QuickTime uses the frame rate of the original source. For many codecs, reducing the frame rate is a key method to improve compression. With Sorenson Video, this is not always the case.

Depending on your video characteristics, Sorenson Video's efficient interframe coding can make reducing the frame rate much less of a factor in reducing the data rate. However, it does take more work to decode more frames. If you have a higher data rate clip, a lower frame rate can improve playback on lower-end computers.

For example, if you are compressing a talking head clip with little motion, cutting the frame rate in half will probably only save you 20% of the data rate. However, if you are compressing high-motion video, reducing the frame rate has a much greater impact on the data rate.

Since video looks much better at native frame rates, we recommend leaving it high if your delivery channels and playback platforms allow it. However, if you need to reduce the frame rate, the best results come from dividing the frame rate by whole numbers. This makes the duration of each frame even, avoiding a stuttering appearance.

Standard features

For example, if you are compressing NTSC video (30 fps), divide the frame rate by 2, 3, 4, etc. for even playback. This results in frame rates of 15, 10, 7.5, etc.

Video standard	Frame rate
NTSC (North Am., Japan)	30 fps
PAL/SECAM (Europe)	25 fps
Film	24 fps

- *Note: Film shot at 24 fps and then converted to NTSC video runs at 30 fps, with occasional repeating frames. Unless you have software that handles Inverse Telecine (After Effects, Media Cleaner Pro 3.0), compress the converted clips as NTSC video (30 fps).*

Keyframe every

The Keyframe every field tells the codec to force a new keyframe after the specified number of interframes. Sorenson Video automatically inserts keyframes whenever the scene changes significantly (based on the Automatic Keyframes setting). However, if the movie has very few scene changes, the Keyframe every setting forces a new keyframe whenever the intraframe counter reaches the specified number.

A Sorenson Video digital movie is broken down into keyframes and interframes. Keyframes are a complete image, just like a photograph. Interframes contain only the information that is different from the previous frame. Since there are generally many similarities between a frame and the frame before it, interframes result in great improvements in data rate efficiency. Sorenson Video's high quality keyframes and efficient interframes are two important factors that make the codec so good at low data rate video.

As a general rule, you want as few keyframes as possible, since keyframes require more data. If the video clip is designed to play straight through, you can specify one key frame every 500 frames. Sorenson Video automatically inserts additional keyframes whenever the scene changes enough that the interframe would be almost as big as a keyframe. (Consequently, fast cuts and lots of transitions use more keyframes which requires a higher data rate.)

If you need to jump quickly to any arbitrary point in the movie, you need a keyframe every 30 frames since the QuickTime "scrub" control only jumps to keyframes. However, that many keyframes can easily triple the file size or more. If there are only certain scenes or points you need to jump to, there are several options.

The codec generally inserts a keyframe (automatically) at each scene change (you can fine tune this with the Automatic Key-Frames feature of the Sorenson Video Professional Edition). Scene changes are the most common jump points and this may be all you need.

You can also use software such as Adobe Premiere™ which lets you place key frames at specific points in the video. If these options meet your needs, keep your keyframe setting high (100-500). Minimum key frames give you the best compression while still maintaining the random access you need. The best method is to compress a sample video and make sure it meets your requirements.

Limit data rate to

- ▶ *Note: If the Limit data rate to feature is not selected, the fixed quality is used*

The Limit data rate to setting specifies the target data rate, in KB/s, for the compressed movie. The target data rate is for video only. Be sure to leave enough bandwidth to cover audio and any other needs.

Standard features

The single most common mistake with new users of Sorenson Video is setting the target data rate too high. Most people are accustomed to other codecs such as Cinepak™ that require high data rates to produce fairly clear video. Sorenson Video requires much less data to produce a clear image.

Generally, quality improves as data rate increases, and the more movement in the clip, the higher the data rate needs to be for the same quality. However, Sorenson Video does have a “quality ceiling.” Beyond a certain data rate, the clip looks almost uncompressed and the quality just doesn't get any better. Sorenson Video's “quality ceiling” is much lower than many other codecs.

For example, a clip that may require 350 KB/s with Cinepak may only need 100 KB/s with Sorenson Video.

As a starting point, use the following formula to establish your compression range with Sorenson Video.

$$Datarate = \frac{Width \times Height \times FPS}{48000}$$

Depending on your video type, Sorenson Video looks good and performs well when the data rate is greater than 1/2 and less than double the result of the data rate formula. For example, a 320x240 30 fps clip yields the following results:

$$Datarate = \frac{320 \times 240 \times 30}{48000} = 48KB/s$$

48 Kbytes/sec is the general target data rate for a 320x240, 30fps clip. However, the movie could go as low as 24 K/sec (1/2) or as high as 96 K/sec (double) and still look and perform well. The higher data rate may impact playback performance on some of the lower end machines, but it will look very clear. The lower end will sacrifice some clarity, but gain playback at the lower end, and it will still look very good.

- ▶ **Note:** High action clips may require a data rate above the 96 Kb/s target for a standard 320x240 clip.

The target data rate formula gives you a starting point. The actual data rate you use depends on the video content and the target playback platforms. Use the above formula as a guide and try several data rates within the range, testing them for clarity and playback on your target platforms. If you need to improve the image quality at your target data rate (without increasing the data rate), try reducing the frame rate or using a smaller frame size. *For additional considerations, see "Video compression guidelines" on page 15.*

For quality improvement at low bit rates, use the variable bit rate options of Sorenson Squeeze or Cleaner 5 (requires Sorenson Video Professional Edition).

Professional features

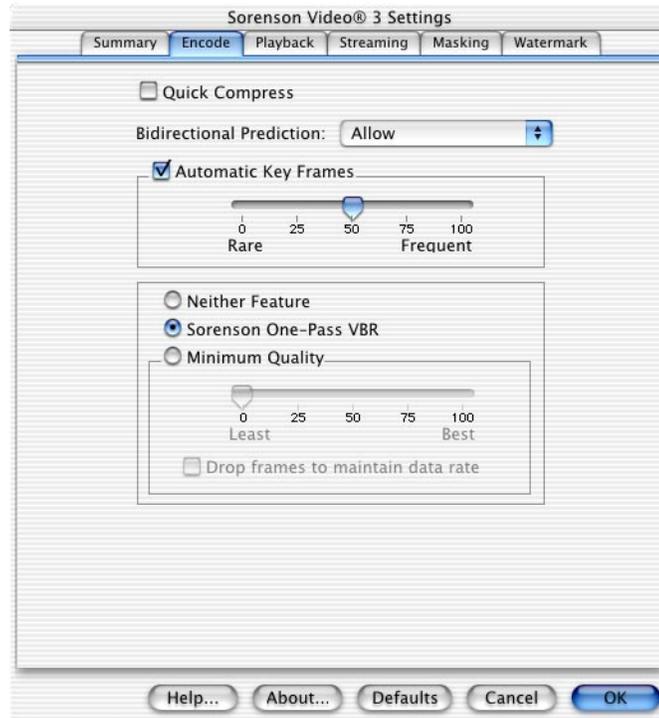
The Sorenson Video professional features are only available to users who have purchased the Sorenson Video 3 Professional Edition. While the standard features allow you to produce good video, the professional features give you the fine control you need to produce great looking digital video, even at very low data rates. In addition, for the very best results, you can use Sorenson Squeeze or Cleaner 5 to access the Sorenson Video variable bit rate features.

The professional compression options are grouped into tabs on the Sorenson Video Settings dialog box. The tabs, with the corresponding options are:

- ◆ Summary—A read-only summary of the current settings
- ◆ Encode—Select encode control options
 - Quick Compress
 - Bidirectional Prediction/Playback Scalability
 - Automatic Key Frames
 - Sorenson One-Pass VBR
 - Minimum Quality/Drop frames mode
- ◆ Playback—Select playback options for compressed video
 - Image Smoothing
 - Media Key
- ◆ Streaming—Enhance streaming performance for RTP/RTSP
 - Slice pictures into packets
 - Force block refresh
- ◆ Masking—Specify masking characteristics
 - Stencil type/Quality
 - Define Masking characteristics
 - Mask Smoothing
- ◆ Watermark—Set watermark
 - Position
 - Pixel Offset
 - Opacity
- ◆ Multiple processor support—automatic

The following sections list each tab with a complete description of the individual features, what they do, and how to use them.

Encode tab



Quick Compress

The Quick Compress option compresses about 20% faster by sacrificing a little quality. The quality loss is minimal and for many applications, this is a very good choice for delivering faster encode times while maintaining most of the video quality.

Professional features

If you need to compress in real-time, your clip should compress without Quick Compress at a ratio of about 1.2/1 (1.2 seconds compression time for every one second of video) or faster. If your clip does not meet that criteria you have several options:

- ◆ Reduce the frame size.
- ◆ Reduce the frame rate.
- ◆ Use a faster computer.

Bidirectional Prediction

From the Bidirectional Prediction pop-up menu you can select Off, Allow or Force. Off turns Bidirectional Prediction off. Allow turns Bidirectional Prediction on, but SV3 decides when it is best to use it. Force for Playback Scalability turns Bidirectional Prediction on always and allows for playback scalability.

A bidirectional frame is a frame created by the compressor and inserted between intraframes and/or interframes. The compressor analyzes the frames before and after the bidirectional frame and then creates and inserts a frame based on the average quality of both. Using bidirectional prediction increases the compression efficiency and the quality of your video. An inherent characteristic of bidirectional prediction, is that it creates a duplicate of the first frame, and drops the last frame. If you have important information on the last frame such as text, you should not select the Use Bidirectional Prediction option.

Playback scalability encodes the video so that if the computer is overwhelmed, QuickTime can drop to 1/2 the frame rate (it skips every other frame). The 1/2 speed option opens up the lower end system significantly without any significant drawbacks. If you are using a 30 fps movie, the quality of the full 30 fps is identical to a straight 30 fps movie and the quality of the 15 fps fallback is identical to a straight 15 fps movie. You don't lose anything in quality and you gain playback capability on the lower end.

With most codecs, when video decompression overwhelms the processor's capabilities, the video freezes on the last frame decoded. The system continues playing audio, and starts decompressing video again at the next keyframe. The result is very jerky video. This problem forces video content creators to compress at the lowest common denominator, or to create multiple copies of the video at different data rates. Sorenson Video's playback scalability provides a much more elegant solution to this problem.

- ▶ *Note: If you are compressing at less than 15 fps, using bidirectional frames causes audio-video sync problems. SV3 automatically turns bidirectional frames off when you compress at less than 15 fps and are not using 2 pass VBR or are using One-Pass VBR. However, when you use 2 pass VBR or Fixed Quality compressions, SV3 always uses bidirectional frames. Therefore, we recommend that if you are compressing with 2 pass VBR or fixed Quality at less than 15 fps, turn the Bidirectional Prediction feature off.*

Automatic Key Frames

The Automatic Key Frames option detects the differences between frames. When the difference reaches the specified threshold, Sorenson Video inserts a new keyframe. The Automatic Keyframes slider lets you specify how different a frame must be from the previous frame before Sorenson Video inserts a key frame. The ideal is to find a setting that inserts a keyframe at the beginning of each scene, without inserting unnecessary keyframes inside individual scenes. The only exception is fast motion scenes which often require additional keyframes. For more information on keyframes, see the basic feature's Automatic Key Frame setting on page 39.

Lower slider values produce fewer keyframes (requires greater difference between frames) and higher slider values produce more keyframes (requires less difference between frames). The default value of 50 is good for most applications. We recommend staying within the 35-65 range for best results. Depending on your content, you may need to compress several times to find the optimum setting.

Professional features

If you use Media Cleaner Pro, the program shows you which frames are keyframes during compression. You can also check with the data rate graph after a clip is done. If you use Adobe™ Premiere™, the Data Rate Analysis option shows you where keyframes are after the clip is compressed.

Sorenson One-Pass VBR

The One-Pass VBR (Variable Bit-Rate encoding) option produces video quality close to 2-pass VBR quality but takes about the same time to compress as non-VBR. One-Pass VBR was developed inside of SV3, and does not require a host software to perform this feature (unlike 2-pass VBR which requires Squeeze or Cleaner). In addition, since it is only one pass, it can be easily used for real-time compression. One-Pass VBR automatically adjusts to maintain stricter data rate adherence if the streaming feature is turned on.

Minimum Quality

It is very challenging to maintain both image quality and a constant frame rate when streaming video for dialup modem delivery. The Minimum Quality option allows you to trade either data rate or frame rate to maintain a specific image quality threshold.

When you turn on the Minimum Quality setting it forces Sorenson Video to keep the picture quality above the specified level. If the quality begins to drop below that level, the codec increases the data rate to maintain the quality.

If you don't want the data rate to increase, select the Drop frames to maintain data rate option. With "Drop frames" turned on, if the quality begins to fall below the specified threshold, the codec drops a frame and uses the data saved to increase the quality, while holding the data rate constant. This action reduces the frame rate temporarily, but increases the quality of the encoded frames. The codec automatically returns to the specified frame rate when it can maintain the minimum quality.

Playback tab

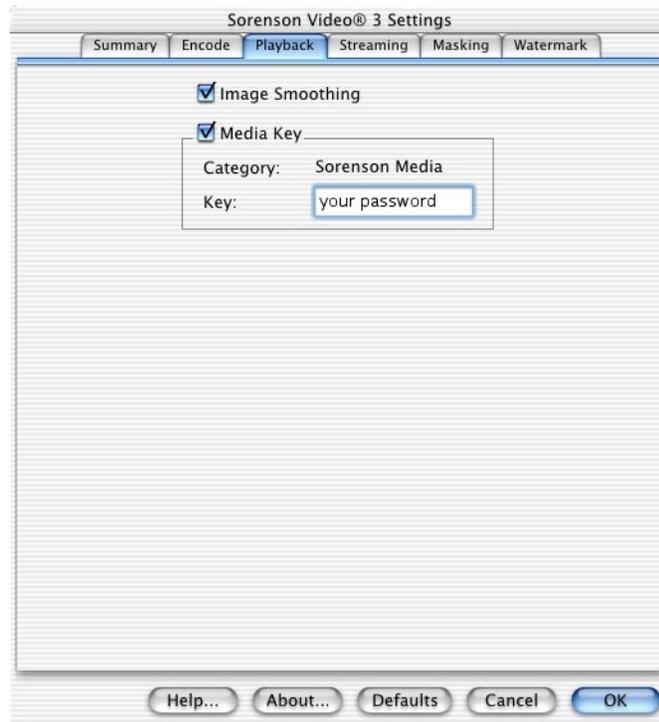


Image Smoothing

When you compress content at Internet data rates, you often see some blocky areas on playback. When you turn on Image Smoothing the decoder evens out the blocky edges on playback. This feature is designed for low data rate delivery and should be turned off for high quality video.

Media Key

A media key is essentially a password for a movie. By setting a media key, you can prevent unauthorized users from viewing the video. When a clip is compressed with a media key, you must supply the correct key to view the video. Media keys are very useful for anyone concerned about security for their video.

For example, if you don't want a user to watch the final movie of a computer game before they finish, set a media key that is not supplied until the game is over (the program can supply it automatically at the appropriate time). Another example is to use media keys to secure video content on an unsecure web site.

To compress with a media key, type the password you want into the Media Key box. The password is case sensitive. Write down the password and keep it in a secure location, or use a password you won't forget. There is no easy way to find out what the password is if you forget it.

Once you compress the video with a media key, there are several ways to give that key to QuickTime. You can add the media key to the QuickTime settings via the Control Panel or you can write your software to deliver the media key directly to QuickTime. *For programming information, consult the API Documentation on the QuickTime developer site (www.apple.com/quicktime/developers/index.html).*

To add a media key to the QuickTime settings:

- 1. From the Control Panel, select QuickTime Settings (Mac) or QuickTime (Windows).**

The QuickTime Settings dialog box appears.

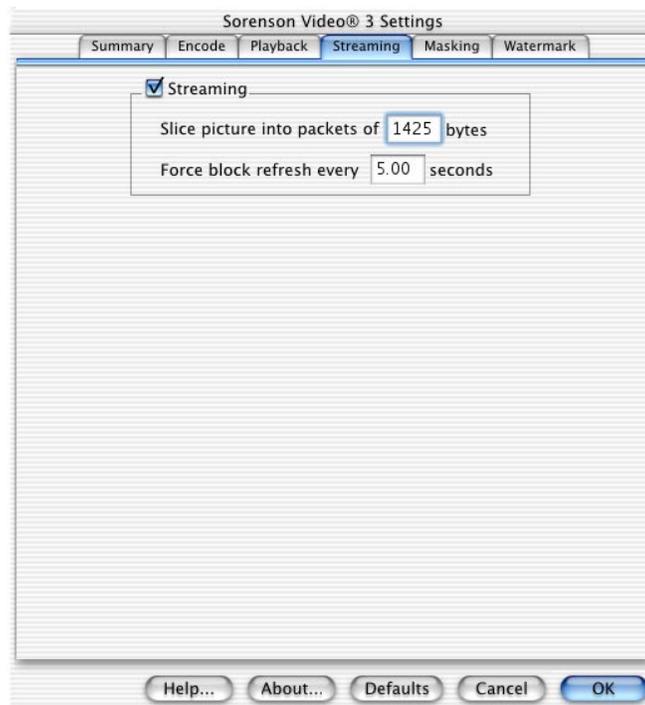
- 2. From the drop-down menu select Media Keys and then click the Add button.**
- 3. In the category field, type "Sorenson Media" (two words, not case sensitive).**

4. In the Key field, type the media key.

After you enter the media key, QuickTime plays any movie that requires the registered key.

- ▶ *Note: Once you turn the Media Key option on, it remains on until you turn it off. If you don't want to encode the next clip with a media key, be sure to turn the option off.*

Streaming tab



Slice picture into packets

The Slice picture into packets feature lets you divide each frame into packets (measured in bytes). Dividing the frame in this manner allows it to lose “packets” of data, but the entire frame is not lost. This option works in conjunction with the QuickTime Hinted Streaming option. In QuickTime the option

equivalent to Slice picture is Packet size limit. The default value should be used. The valid range of values for slice size is 512 - 1450. However, if you change the QuickTime Hinted Streaming option setting, you must set the Slice value at 20 less than the QT setting.

Force block refresh

As was mentioned in the “Sorenson Video compression” introduction, Sorenson Video is an interframe codec. This means that each frame of video is described based on the difference from the preceding frame. Each keyframe begins a new interframe dependency.

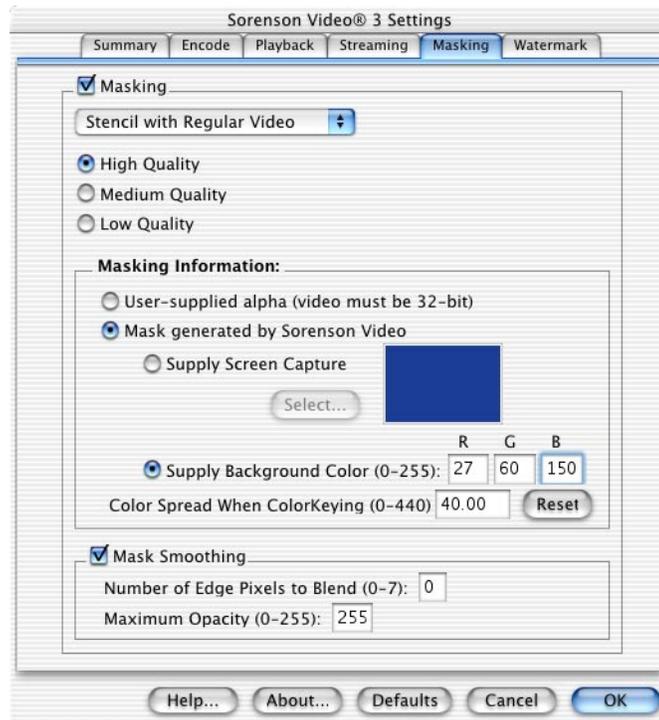
As each frame of video is compressed, it is divided into 16x16 blocks (vectors). The encoded blocks are sent and reconstructed by the decoder on the other end. *For a more detailed discussion of the encoding process, see “How Sorenson Video works” on page 12.*

In between keyframes, only those blocks that are substantially different from the preceding frame are updated. Areas of video that remain the same (e.g. backgrounds or stationary objects) are not updated until the next keyframe. The Force block refresh option allows you to specify a maximum refresh period (in seconds) for all blocks within the frame. If a block has not been updated when this period expires, the codec forces a refresh of that block.

A forced refresh period is very important when using RTSP to stream video over the Internet. If data gets lost during transmission, the block or blocks may appear garbled on the reassembled video. Without a forced refresh, the lost data would remain garbled until the next keyframe. The forced refresh setting helps you deliver the highest quality streaming video possible.

For more information on video delivery methods, see “Delivery mechanism” on page 17.

Masking tab



The Masking tab gives you options that let you isolate the foremost part of your video so you can insert an image, movie or other video sequences as the background. This feature works similar to chroma-key. For example, when you watch a weather report on TV the reporter is standing in front of a “blue-screen” background while a computer inserts video images as the background.

To take advantage of the Masking capabilities of Sorenson Video 3.0 Professional Edition, create your own “blue-screen” set, and shoot your video sequence against that background. The codec needs to know the screen color so that it can extract the foreground from the screen, a process called Color Keying. When compressing the codec will ask you for: (1) the RGB

color or (2) an image file containing a snapshot of your “blue-screen”. In addition to the screen color, the user can also input a color spread that specifies how far (in Euclidean distance) RGB colors can be from the target screen color and still be considered background.

Stenciling

Stenciling determines the method you want to use to extract the foreground from your video.

The first masking option lets you select what type of stenciling you want to use. From the drop-down menu you can select one of two stenciling methods. You can also select the quality with which you want to compress the stencil. Following is a description of these options:

- ◆ Stenciling Alone—This option extracts the foreground shape information only and does not compress any of the color (texture) in the foreground.
- ◆ Stenciling with Regular Video —This option adds to the option above by including all the foreground texture.
- ◆ Stencil Compression Quality—High corresponds to lossless compression of the stencil, Low corresponds to minimal quality.

Masking information

Masking information options let you characterize the background you want to insert in your video. Following is an explanation of the options.

- ◆ User-Supplied Alpha—select this option to compress video that already has a stenciling or alpha mask associated with it. If that mask is a regular 8-bit alpha mask, then it is converted to a binary mask. Partial transparency detailed by an 8-bit alpha mask is lost, but the shape is retained.
- ◆ Mask generated by Sorenson Video—select this option if you shot “blue-screened” video.
 - Supply Screen Capture—you provide an image file of the screen as it will be lighted during the shooting of

the video.

- Supply Background RGB Color—enter the color of the background of your “blue-screen” video.
- ◆ Color Spread When Color Keying—designates how far (in Euclidean distance) RGB colors can be from the target screen color and still be considered background.

Mask Smoothing

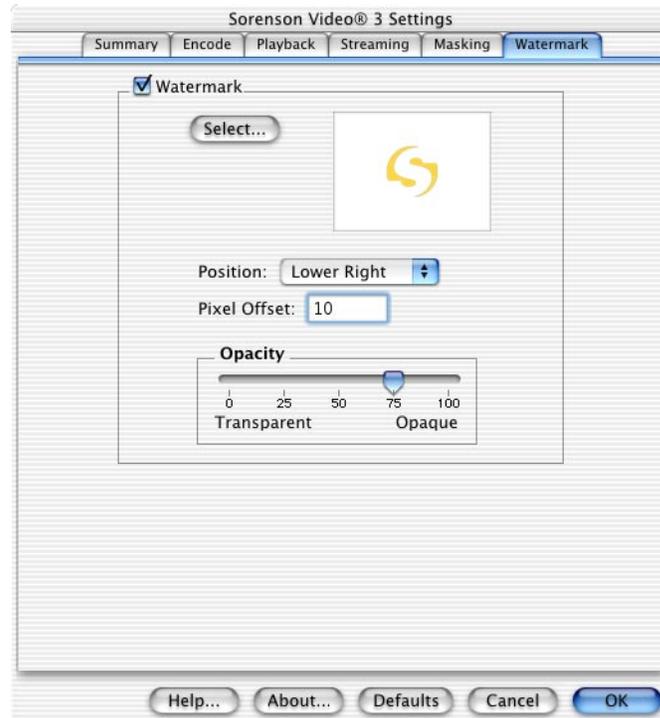
You have the option whether or not to enable Mask Smoothing. If you do not enable Mask Smoothing, Sorenson Video 3 does not feather the edge of the binary alpha mask during decompressing. This option leaves crisp edges between foreground and the inserted background.

If you enable Mask Smoothing, you have two features for controlling the feathering.

- ◆ Number of Edge Pixels to Blend—specify how far into the foreground (measured inward from the boundary of the foreground) the background will be blended. This choice can mask some edge effects.
- ◆ Maximum Opacity—change the opacity of the foreground video. This feature can be used to create a ghost effect. Amount of opacity is measured in values from 0 to 255, with 255 being completely opaque and 0 being invisible.

Professional features

Watermark tab



With the Watermark feature, you can select and place a custom watermark on your encoded video. You can use the watermark as copyright protection, or simply as a seal indicating who produced and/or compressed the video.

The image for your watermark is inserted into the data stream header and placed on each decoded frame at playback. The watermark is compressed with a lossless algorithm and does not lose quality, regardless of your compression ratio. The watermark also does not increase the data rate requirements or take bandwidth from the video data.

- **Note:** *The watermark cannot be altered or removed from the video clip. If someone attempts to remove the watermark from the video stream, the clip will no longer play.*

Position

Specify where on your video frame you want your watermark to appear: upper or lower right, upper or lower left.

Pixel Offset

Specify the distance, in pixels, you want the watermark offset from the selected position. For example, if you selected lower right as your watermark position, you can offset the watermark 10 pixels from the lower right edge.

Opacity

Move the slider to specify the opacity or transparency of your watermark. Opacity is defined on a scale of 0-100 with 0 being completely transparent (you can't see the watermark) and 100 being completely opaque (you can't see through the watermark—except for the transparent color).

Setting a watermark

Create a grayscale or color Pict (Mac) or BMP (Windows) image to use as your watermark. The color of the top left pixel defines the transparent color. For example, if the top left pixel is white, then all white pixels in the image are transparent in the watermark. All non-transparent pixels cover up the video underneath, depending on the opacity settings.

- *Note: Very large watermarks may cause playback problems on slower computers simply because of the processing necessary to lay the graphic over the video. If you plan on using a watermark with slower computers, keep the mark small to avoid any possible problems.*

Follow the steps below to set a watermark in your compressed video.

1. **In the Sorenson Video Settings dialog box, select the Watermark tab.**
2. **Select the Enable Watermark box.**

Professional features

The file dialog box appears and the Watermark options become available, allowing you to select and define the placement of your watermark.

- ▶ *Note: If you decide not to use the watermark effect, you can simply unselect the Enable Watermark option and recompress your video.*
- 3. From the file dialog box, locate and select the image you want for your watermark.**

After you select the watermark file, the watermark is displayed in the preview window. The preview window allows you to verify your watermark selection prior to compressing the video.

- ▶ *Note: Depending on the size of the watermark, it may appear scaled in the preview window. The watermark itself is not changed, the dialog simply scales the preview to fit the window.*

Now that you have chosen the watermark file, you can define where the watermark appears on your video.

- 4. From the Position drop-down list, select the watermark location you want.**
- 5. Enter the Pixel Offset you want.**

The final step is to define the opacity of the watermark.

- 6. Set the watermark opacity you want.**

The best way to preview the watermark opacity is to actually compress the video. You may want to compress a small segment of video to test the watermark placement and visibility before compressing the entire clip.

- ▶ *Note: If you are using Cleaner 5 to compress your video, the dynamic preview window shows the watermark, allowing you to preview the finished results before compressing.*

If you want to change the watermark image, click the Select button and follow steps 3-6.

Multiple Processor Support

Sorenson Video Developer Edition supports encoding with multiple processors. If you have a multiprocessor system, Sorenson Video will use the additional processors to increase encode speed. Table 3 shows the estimated performance increase with multiple processors. Actual performance will vary depending on your system configuration.

Number of CPUs	Performance increase
2	1.8x
3	2.4x
4	3.2x

Table 3: Multiple CPU performance estimates

Enhanced data rate control with Cleaner 5

Sorenson Media has teamed with Terran Interactive, makers of Cleaner 5, to offer some features that greatly enhance the compressed video quality. Cleaner 5 offers additional data rate control options with Sorenson Video that allow you to fine tune your video compression and achieve maximum quality at a given data rate. The data rate controls are:

- ◆ Variable bit rate (VBR)
- ◆ Flat rate
- ◆ Spike suppression

Variable bit rate

The feature that produces the most noticeable difference is variable bit rate compression (VBR). VBR can produce fabulous finished movies, even at very low data rates with high motion clips. With VBR, Cleaner 5 analyzes the entire movie before it begins compressing, figuring out the best way to compress the video within your given compression parameters.

After the analysis, Cleaner 5 compresses the clip, allocating more bandwidth to high motion or complex sections and less bandwidth to simpler sections. All this is done while maintaining, on average, your specified target data rate. The Terran documentation is very thorough and we recommend you refer to it often, however, this section will provide you with a few tips as a starting point.

When you use the Cleaner 5 compression settings, you must consider your intended delivery method. With low data rate movies for HTTP delivery, you can generally set a very high peak data rate. Even if the movie is only at 5 KB/s average, you can have a peak at 60 KB/s if there are a few points of very high motion in the clip. However, in the CD-ROM environment, you need to make sure that your peak data rate isn't too high for your target platform.

As a general rule, you should set the peak data rate at twice your target data rate (the Cleaner 5 default). However, many times it works well to use a very high peak rate. With a high peak rate, Cleaner 5 has a lot more flexibility to accommodate the content. You can use the Cleaner 5 data rate analysis graph to observe the data rates throughout the clip.

- ▶ *Note: Be very careful when using VBR with RTSP delivery. Too much variation in the data rate could cause the stream receiving buffer to overflow and lose data. The user would lose part of your video.*

Always test your final compressed movie on your target playback platforms. If you set the peak too high, you may get dropped frames on some low-end computers. It is always easier to test first than to try and fix problems later.

Flat rate

The Cleaner 5 “flat rate” compression option maintains a consistent frame size throughout the entire clip. While flat rate encoding produces a predictable data rate, it does not allow for any variability in the data stream as the content changes. Using a flat rate may result in lower quality in areas of high motion, unless you use higher data rates.

Spike suppression

Spike suppression allows the data rate to fluctuate as needed, as long as the rate never exceeds the specified “Spike” level. Spike suppression can be useful when compressing for CD-ROM where the average data rate is less critical than the peak data rate. However, don’t forget to test and verify that the target playback platforms can play smoothly at or below the spike level.

Enhanced data rate control with Cleaner 5

Streaming Media

The phrase “streaming media” is commonly used when referring to video and audio content delivery over the Internet. Streaming media can take the form of live broadcasts of video or audio streams and it can also refer to delivery of stored media files, played on demand. Both data types can play as the information downloads to the viewer.

There is some misunderstanding as to what “streaming” really means. Based on common usage, streaming media refers to the ability of a media file to play as it downloads. From the perspective of most end users, when they click on a file and it starts to play, that is streaming.

There are two types of streaming: RTSP and HTTP. Both methods play video as the file downloads. Which method you use depends on your streaming requirements.

RTSP streaming

In general, the streaming industry defines streaming as RTSP (Real Time Streaming Protocol) streaming. RTSP streaming has the following characteristics:

- ◆ Media plays as it downloads.
- ◆ No media file is stored on the local computer.
- ◆ Requires a special “media” server.
- ◆ The server controls the transmission rate (“push” streaming).
- ◆ Uses UDP, a “lossy” transmission protocol (if data is corrupted or lost during transmission, it is simply discarded).

RTSP streaming is often referred to as “push” or server-based. A common example of RTSP streaming is Real Media (Real Audio/Real Video).

RTSP streaming is a relatively new technology designed to deal with real-time (live) transmissions over IP networks (e.g. the Internet). To help deliver the information in real-time, RTSP uses UDP as the transmission protocol. UDP is a lossy protocol that basically sends the data out without checking to make sure it arrived. When sending real-time data, replacing lost packets doesn’t work. By the time the replacement data packet arrives, it is no longer needed (it is out of date).

Advantages

RTSP streaming has several advantages:

- 1 No local file storage.
Since RTSP streams are not stored by the viewer, these streams work very well for long video segments, or for live/continuous broadcasts (radio or television feeds).
- 2 Random access with stored streams.
When streaming stored files, the user can jump to any arbitrary point in the video stream without downloading the entire stream.

- 3 Bandwidth control.
The streaming server determines the bandwidth of the stream. The viewer simply takes the data that is broadcast, regardless of their Internet connection speed (you can match the stream bandwidth with the user's connection speed). Since the streaming server controls the bandwidth of the stream, it is much simpler to plan for peak download times.
- 4 Multicast transmissions.
Multicast sends out a single stream that branches only when it needs to. Multicast helps to reduce network congestion by minimizing the number of streams at any given time. Not all networks support multicast (large portions of the Internet do not yet support it).
- 5 Unicast transmissions.
Unicast sends a separate stream to each client. Each time someone accesses the clip, a new stream is created. If too many clients access the stream at once, it can quickly clog the network. However, most networks support unicast making it a very reliable way to deliver RTSP streams.

Disadvantages

As with any technology, there are also some disadvantages.

- 1 Lost data packets.
Lost data packets may result in the viewer not receiving the full quality of the original stream. The lost data may cause some blocks to appear scrambled because they lack the complete information necessary to reconstruct properly. Sorenson Video's "Forced Block Refresh" option helps overcome this problem.
- 2 Trouble with firewalls.
A current concern with RTSP streaming is that many firewalls do not allow UDP transmissions to pass. Firewall administrators can easily change the configuration to admit streaming data, but the initial failure can easily lead to confusion and frustration for your viewers. Once RTSP/UDP becomes a more established transmission system, this concern should go away.

RTSP streaming

- 3 Must deliver stream at the client's connection rate.
If you deliver a stream in excess of the client's connection rate, the download buffer will fill up and overflow. The video that overflows is simply lost and the client may see "holes" in the video where the excess data was lost. You can produce multiple streams for the different data rates (much like QuickTime's movie alternates), but each stream must stay within the data rate boundaries.

HTTP streaming

HTTP streaming uses the standard internet “HyperText Transport Protocol” (HTTP) to deliver stored media files. This is the same protocol used to transmit information from a web server to your web browser. HTTP streaming was introduced as part of Apple’s QuickTime 3 and is referred to as “progressive download.”

Advantages

HTTP streaming is a very convenient streaming solution with several advantages.

- 1 No media server required.
The media file resides on a standard web server, thus eliminating the extra expense of a separate media server. Media servers can be very costly.
- 2 Simplified setup of media files.
Since there is no streaming server, all you have to do is create the media clip and place a link to the compressed file on a standard web page.
- 3 Local storage of files.
The file plays as it downloads and the finished download is stored in the local computer’s Internet cache. The user can then view the file multiple times without having to download the file each time.
- 4 Deliver media independently of the client’s available data rate.
If you want to deliver a media file with a data rate of 8 KB/s (equal to 64 Kb/s) and the client only has a 56 Kb connection, the browser client simply buffers more media before it starts to play. This feature allows you to dramatically improve the video quality while still streaming your video.
- 5 Lossless transport protocol.
Any missing data is sent again so the user never experiences media quality loss due to transmission losses.

HTTP streaming

Based on these advantages, HTTP delivery is a very good way to deliver short clips to a broad audience. Most movie trailers we see out on the Internet are delivered via HTTP. It doesn't make sense to try and stream these short previews. Plus, HTTP delivery allows the user to save the clip and pass it on to friends (better exposure), the download is lossless, so the quality of the clip is guaranteed, and you can set the data rate to maximize display quality without worrying too much about the end user's connection speed.

Disadvantages

Like any technology, HTTP delivery is not perfect. There are also some disadvantages:

- 1 Local storage of files
 - If you are concerned about control of your video, HTTP is not the best delivery mechanism. Once the user downloads the video, the file is beyond your control (although Sorenson Video 3 Professional Edition's watermark feature may help alleviate this concern).
 - Local storage restricts the streams to short or moderate length files since long files may overwhelm the local storage resources. For example, An hour of video at 56K modem rates occupies about 30 MB of storage space. If you need to stream longer files, try using RTSP.
 - The viewer does not have random access into the stream until the file is completely downloaded.
 - File-based download eliminates the possibility of live event streaming.
- 2 Lack of server bandwidth control makes it very difficult to project and schedule for peak download demands. The client downloads the file based on their current connection rate, not server restrictions.
- 3 The lossless protocol can slow download times as lost packets are retransmitted. This can increase network congestion.
- 4 HTTP streaming can only use unicast transmissions (one stream for each client).

Summary

With the release of QuickTime 4, Apple Computer provided access to both HTTP and RTSP streaming technologies. Using QuickTime, you will have the choice to deliver your media files through either or both (even in the same file). QuickTime lets you select the delivery method that best meets your needs.

If you are streaming live content or very long video clips, RTSP is the clear choice. If you are delivering short video clips and want to ensure high quality regardless of the user's connection speed, HTTP is the best choice. QuickTime allows you to select the technology that best meets the needs of your video and your audience.

In some cases, you may even want to combine the streaming methods. For example, you want to deliver a presentation or seminar over the Internet. You can create an audio stream for RTSP delivery and then combine it with an HTTP stream for the accompanying slides and graphics. HTTP provides the guaranteed quality necessary to deliver usable graphics for your online presentation. Table 4 compares the features of RTSP and HTTP streaming.

Table 4: RTSP vs. HTTP streaming

Feature	RTSP Streaming	HTTP Streaming
Playback during download	Yes	Yes
File stored locally	No	Yes
Requires media server	Yes	No
Transmission bandwidth control	Server	Client/ Network
Transport protocol	RTSP (lossy)	HTTP (lossless)
Firewall issues	May be blocked	Passes through

Summary

Table 4: RTSP vs. HTTP streaming

Feature	RTSP Streaming	HTTP Streaming
Random access	At any time	After download only
Length of stream	Unlimited (live broadcast)	Limited (file-based)
Unicast	Yes	Yes
Multicast	Yes	No

Audio Compression

Most movies are made up of two parts, video and audio. Historically, the video portion of a digital movie was so large that the audio was only a minor piece of the puzzle. However, with Sorenson Video's excellent compression capabilities it is possible to create a file where audio is the largest portion. To get the best out of Sorenson Video, you also need a good audio compression format.

Audio production

The same considerations exist for audio production as for video production. In order to achieve good audio compression, you must begin with clean audio. If you are encoding material from a CD, try to record the file via direct digital transfer instead of through the analog input of your sound card. The sound card introduces an unnecessary digital-to-analog and analog-to-digital conversion that can create noise in your source audio. Direct digital transfer tools are available for both Mac and PC platforms. If you must record from an analog source, be sure to use the highest quality sound card available.

Make sure the input levels are set appropriately and that the input signal is not "clipping" (hitting full scale signal strength). To monitor the input level, watch the level meter associated with the input volume control, external mixer, or audio recording application. A good setting for the input signal level is about 2 dB below full input load level (below clipping).

Digital audio

Before you pick the audio compression format, it is important to understand a few facts about QuickTime audio and audio in general. Digital audio is measured in samples per second (Hertz or Hz). CD audio is 44.1 kHz, and is the maximum most systems can use. 44.1 kHz stereo audio has a data rate of 150 KB/sec. which is much too high for most applications without compression.

Historically, most multimedia audio was sampled for compression at 22.05 kHz or 11.025 kHz. The sampling rate you need depends on the type of audio you are using. For all music, 44.1 kHz is ideal, but 22.05 generally sounds adequate. For voice, 22 kHz is more than enough and 11 kHz sounds pretty good. For voice in very constrained environments, 6 kHz is acceptable for male voices and 8 kHz is acceptable for female voices.

Audio is digitized as either 8-bit or 16-bit. Multimedia audio has often used 8-bit audio to save space, but the current multimedia audio codecs provide better compression and quality in 16-bit and often don't work in 8-bit. We don't recommend using 8-bit audio with Sorenson Video.

The audio file size is generally proportional to the sampling rate, with stereo doubling the file size. Unless you know your audio has significant differences between the left and right channels, it's generally best to encode to mono to save space and processing power. The typical tools for reducing the data rate are: reducing the sample rate, converting to mono, and digital compression. QuickTime has three basic audio codecs that work very well with Sorenson Video: IMA, Qualcomm PureVoice, and QDesign Music.

QuickTime Audio codecs

While audio may be less data intensive than video, it still requires 11 MB of storage for one minute of uncompressed, CD-quality sound. To reduce these data requirements, there are a number of different audio codecs. These different audio codecs deliver different audio quality, based on your source. To compress the highest audio quality, it is important to understand the characteristics of the audio source. Audio that is well produced with clear instruments and vocals will encode very well, while material that has significant background noise may have more noticeable artifacts in the encoded output.

IMA

The IMA audio codec has been in QuickTime since version 2.1. IMA offers good quality and playback performance at reasonable data rates. It compresses 16-bit audio at 4:1, so a 22kHz mono track would compress to 10Kb/sec. In a CD-ROM environment where processor power is more of a concern than overall data rate, IMA is a good choice.

Before QuickTime 3, IMA was the only real audio compression solution in QuickTime. But to retain 44.1 kHz stereo sound, IMA would have to encode at 384 Kbits/sec. To enable audio to transmit in real-time over a 28.8 dialup internet connection, the source file would need to be re-sampled to 4 kHz mono. The resulting quality would be unacceptable.

PureVoice

QualComm PureVoice codec is another built-in QuickTime audio compression codec. This is the same codec used in QualComm digital cellular phones. PureVoice is an outstanding specialized speech codec, but outside of speech, its uses are limited. PureVoice offers good performance and excellent compression. There are two compression modes, full and half. Full compresses at 9:1 and half compresses at 19:1.

QuickTime Audio codecs

In general, speech codecs are designed to perform best when encoding speech, or speech-like sounds. Speech compression technologies are based on modeling of the human speech generation process. Speech codecs are generally intended for telephony applications that do not transmit any other sounds except for human voice. This means that any dialog with ambient sounds or background music is difficult for a speech codec and often results in poor quality. However, in pure-voice applications, speech codecs can provide good quality at lower data rates than most audio codecs.

QDesign

QuickTime 3 (and later) contains the Basic Edition of the QDesign Music Codec. The QDesign Music Codec excels in its ability to deliver unparalleled audio quality at the lowest data rates on source material with wide frequency response. Music and sound effects can be encoded at up to 100:1 with outstanding results. For the most advanced solution for mastering compressed audio, professional multimedia content developers should use the QDesign Professional Edition.

Music codecs differ from speech codecs in that the technology is designed to encode both speech and natural sounds. Music codecs require an in-depth understanding of the human auditory system in order to develop techniques that can accurately model and replicate the perceptual sound experience.

The QDesign Music Codec is a new generation technology that offers tremendous flexibility in compression ratios and unsurpassed encoded audio quality at the lowest data rates. Depending on the source material, users can publish broadcast-quality sound for real-time distribution on the Internet at as little as one percent of its original file size. The original 11 MB, one-minute file can now be compressed to as small as 110 KB with a data rate of only 20 Kb/sec—easily deliverable over dialup modem rates.

For more information on the QDesign Music Codec, visit their web site at www.qdesign.com.

Multimedia production process

This section is designed as an overview of the multimedia production process. The information covers all aspects from design to final distribution. However, this section does not give a lot of detail on how to perform each step, but merely highlights the process and provides you with a few tips to get you started.

The focus of our process here is producing multimedia movies for CD-ROMs and web sites. It is not intended for people who use the computer as an editing and effects machine, in order to output back to tape. While some of the information contained here is useful for the tape output users, the focus is on the specifics of low bandwidth multimedia preparation.

- ▶ *Note: The information in this section is provided courtesy of Terran Interactive. Additional information and updates can be found at their web site (www.terran.com).*

Overview

Most multimedia applications involve both video and audio. The information provided here focuses mostly on video, but many of the tips are equally valid for audio. The key is to preserve as much quality at each step as possible, providing the best possible source for compression.

Making multimedia movies involves the following steps and tasks:

- 1 Start with good source material. Higher quality originals will give you better finished movies.
- 2 Capture the video clips (including audio).
- 3 Edit your video clips with an editing program. Save the edited file uncompressed (the file will be fairly large). You can also add special effects to your video at this stage.
- 4 Compress your movie. The compression step is often overlooked, yet has a dramatic impact on the quality of your finished movie. You must compress your movies prior to distribution.
- 5 Distribute your final compressed movie.

Source

There are several ways to generate movies for your multimedia projects. We're going to focus on live video. You can also make your source movies with 3-D rendering and animation packages, paint programs that let you paint over time. You can even license completed video from others.

It's beyond the scope of this section to go into the technical details of creating good video. However, following are some general tips aimed at multimedia content. Most of these tips are focused on creating movies that will compress well, since the compression phase is where most of the loss of quality occurs in multimedia production.

- Use high-quality originals

The higher the quality of the original, the better the final movie. While frame rates and sizes of a QuickTime movies are usually less than what you see on a television, computer monitors have much better color fidelity, saturation, sharpness, and resolution than a conventional television. Even with a small window, image quality can be more important for digital video than for standard analog television. Artifacts and noise that would hardly be noticeable on TV can be painfully obvious on the computer.

Using BetaCam SP will give you a much nicer looking final compressed movie than VHS. A lot of people make the mistake of thinking that the source doesn't matter since the final movie will be small and grainy due to its low data rate. This assumption is absolutely wrong. The better the original, the less noise there will be in the signal. Less noise equals better compression and hence a superior final image. A high quality original is the first important step towards a high quality final compressed movie.

BetaCam SP is generally the best, the digital video cameras are the next best option, S-VHS and Hi-8 are OK, and VHS is the last option. (Pixel Cams are should not be used, unless you're going for grainy art.)

Source

Audio should be clean and free from excessive background noise. Professionally produced audio with the proper equipment will yield the best compressed sound. Cutting corners in the production phase will cost you during compression.

□ Light for compression

Generally speaking, movies that are well lit and don't have a lot of contrast will compress better than very dramatically lit videos. Make sure to use enough lights. Low light conditions produce high-grain which is terrible for compression. If you want to do "art stuff," fine, but realize that the final edited and compressed result may not match what you see on the video monitor.

□ Use a tripod

We can't emphasize this enough. Keep your camera rock steady—any movement will make the final signal much harder to compress. On a TV, a single pixel movement may not matter, but with multimedia movies, that movement can radically degrade your compression. This is a factor of temporal compression. *For a more complete explanation, see "Temporal compression" on page 11.*

If you like the hand-held effect, you'll also get the "pixelized" effect of poor compression that goes along with it.

□ Keep detail to a minimum

If you are shooting an interview, keep the background simple. This makes the image easier to see when it is reduced to the smaller dimensions frequently used for multimedia production. Keeping the detail to a minimum also helps the image compress better. Painted backdrops are great for this.

Don't film people in front of windows if there is a lot of stuff visible outside. The extra detail makes a confusing image when it's reduced, and it doesn't compress as well. If you can't eliminate the excess details, you can throw the background out of focus to minimize it.

- **Beware of excess movement**

When shooting video for the Internet or other low bandwidth delivery, try to keep overall motion low. Long sequences of high motion require a higher bandwidth for clear reproduction. For example, high action sports sequences require a higher data rate than a “talking heads” interview. While QuickTime, with the Sorenson Video codec, does a great job with high motion video, you need to keep in mind the restrictions of the delivery channel.

High motion video is best delivered via CD-ROM or intranets, where the delivery channel is large enough to accommodate the higher data rates. That is not to say you can't use motion in low data rate video. Using data rate tracking or variable bit rate encoding, you can accommodate short bursts of motion, even with narrow delivery channels like the internet. *For additional information on these features, see “Sorenson Video 3 Feature Reference” on page 29.*

- ▶ ***Note:** Trees have a lot of detail and make poor backdrops. Trees blowing in the wind are one of the worst backdrops imaginable. The constant motion and shifting detail make the finished video very difficult to compress. Running water also makes a poor backdrop.*

- **Run tests**

Shoot tests of your material and run it through the entire system to see what the final output will look and sound like before you go into production. It's important to test the whole system. Your image may look great as a raw capture, beautiful when edited, but look terrible when you're done compressing it.

Testing can be an arduous process, but it is invaluable for saving you time, money, and general misery. This is the single biggest thing you can do to improve your final results and head off problems before they become disasters.

Source

Summary

The overall goal of creating good multimedia video is to:

- ◆ Reduce or eliminate video noise
- ◆ Eliminate unnecessary camera movement
- ◆ Minimize fine details

If you can approach or achieve these goals, your final movie should compress well and look good at small screen sizes.

Capture

The next step in the multimedia video process is to get the video from the tape into your computer. Generally this is done with a digitizing card. AV Macs have built-in digitizing boards, and you can also buy cards from other vendors to put into your Mac or PC.

How they work

The basic principal behind a capture card is that it takes the analog video and audio signals, runs them through an analog-to-digital converter to produce digital signals, compresses the signals with special chips on the board, and then stores this compressed information on a hard-drive. Depending on your system, drives, etc. the captured signals may be 1-20 Mb per second. Needless to say, this will fill up a hard drive fast, so you'll need massive drives for even short movies—start at 4 Gig and work your way up. Make sure to get “AV” drives that don't periodically pause to recalibrate themselves.

The bigger the capture is per second, the faster the drive needs to be to keep up with it, and the less movie you'll be able to store on a given drive. However, higher capture rates generally yield higher image quality. You want the best signal you can afford, because this gives you the best final movie.

Hardware compression

Captured video is usually compressed with special chips on the capture card (often in a motion JPEG format) before being stored on the hard disk. This hardware compression makes your movie smaller, but the hardware compressed movie is only viewable by computers with the same hardware installed. For example, if you compress with a Targa card, you need that same card installed to watch the movie properly, because the chip that decodes the compressed video lives on the card.

Capture

With hardware compression, you can't distribute raw captures to the general public; it's unlikely that any significant number of them own a capture card, not to mention the same capture card as you. In order for a movie to be viewed by people who don't own the same hardware as you, you must change the format to software-only compression - this happens in Step 4, Compression. *For more information, see "Compress" on page 82.*

- ▶ ***Note:** There is ongoing work to standardize the various hardware codecs, but this hasn't happened yet. In the future, which hardware card you have may be less of an issue, however, standardized codecs won't change the fact that hardware compressed movies must have an appropriate hardware card installed in order to play smoothly, so they will probably not be a good final format for your multimedia movies.*

Pricing

Generally speaking, you can spend as much money as you want on a capture card or system. The high end solutions easily go over \$100,000. But don't worry—prices have really come down, and you can get a good card for under \$1000. Bottom line, buy the best card you can afford if you are doing this professionally, which probably means a card in the \$2000 + range.

If this is a hobby, you can probably get a card you'll be very happy with for under \$200. If you don't already have a computer, look at pre-configured systems, which are often fairly inexpensive. If possible, go to a store, reseller, VAR or training center where you can use the card or system you are considering prior to buying it.

Tips

Following are some tips to help you as you get started.

System. Getting your system properly configured to capture video and audio can often be a frustrating experience. See our Capture tips section for some specifics of how to "tune" your system for capture. Following are some guidelines.

- ◆ Generally speaking, you want as minimal a system as possible (unload all unnecessary extensions and control

panels).

- ◆ Make sure you don't have virtual memory or any memory-enhancing programs running (like RAM Doubler).
- ◆ Don't use a screen-saver.
- ◆ Capture to a fast drive that you've defragmented or just erased. For really high quality captures you may need a SCSI accelerator card and possibly a disk array.
- ◆ Take all unnecessary devices (scanners, etc.) off the system.
- ◆ Turn off any networking.
- ◆ Place a diskette in the internal floppy drive (the system sometimes checks the drive - having a disk in it stops it from doing this—*Mac only*).

Capture applications. Your capture card probably came with an application designed to control the capture process. Many cards are shipped with Adobe Premiere, and AV Macs usually have MovieRecorder installed. Follow the instructions with the software. If you do use Premiere, make sure to select the "Warn on Dropped Frames" option so you'll know if some frames are missing.

Watch for dropped frames. The biggest problem is dropped frames. This means that some frames are missing. For example, even though you may want to capture your video at its original 29.97 fps, you may really only be getting 15 fps. Dropped frames may also be sporadic, causing the video to occasionally pause for a fraction of a second at random times. There's not much you can do to fix dropped frames after the fact, so keep working with your system until you get zero dropped frames during your captures.

- ▶ **Note:** *NTSC video is 29.97 frames per second, and many applications try to capture at 30 fps. This difference in frame rates may mean that you get a warning that you have dropped frames when you haven't. In Premiere, you can look at the length and frequency of the dropped frames to see if this is a problem or not. A few frames with a similar time base to the rest are usually indications of this timebase issue, and are not a problem.*

Capture

Usually dropped frames result when you're trying to capture video that is too big (in Mb/second) for your system, or you have a configuration problem. Try turning down the "quality" of the capture to see if this fixes the problem. Test your drive to see what kind of transfer it can handle. Read your capture hardware and software manuals for more information on fine tuning it, and check our Capture Settings tips for some other hints on optimizing your system for capture.

Capture settings. As mentioned above, you want to capture video at the highest possible quality. This means full screen if possible, with 44 kHz, 16 bit audio (stereo is only needed if the final output will be stereo). Even if you intend to make a 320x240 final movie, a 640x480 capture will give you better results. This is due to the fact that when you resize a larger image to a smaller final size, several pixels are averaged to make each final image pixel. This averaging tends to reduce video noise and improve the image quality.

Also, there is often "edge noise" around the perimeter of your captured video which must be removed. This is another good reason to capture larger than the desired final size.

Most capture cards are optimized to capture at 320x240 or 640x480. We don't recommend capturing at odd sizes, because this often requires your computer to resize on-the-fly which can slow down the process and cause dropped frames.

TEST! Make sure to test your capture system before capturing all your clips. Audio levels are often different from when you capture and when you play back. Do yourself a favor and go through the entire production process (from source to distribution media) with some sample video before starting production.

Summary

In the capture step you:

- ◆ Convert the analog source to digital files
- ◆ Store the digital files on a hard drive

In order to capture video accurately you need a:

- ◆ Capture card
- ◆ Fast hard drive
- ◆ Finely tuned computer system

The captured video is usually only viewable by people who have the same hardware as you, so you need to make your final video in a format that is not dependent on your capture card.

Edit and Add Effects

This is the fun part of the process where your creativity gets to shine. Editing is where you take the various pieces of your movie, assemble them in order, and possibly add fun transitions and effects.

Basic edits

For basic editing, Apple's QuickTime MoviePlayer lets you do simple cuts, and it's inexpensive. Just open all your original movie clips in MoviePlayer, create a new movie, select the sections of the original movies that you want to use, and then paste these pieces in the order you want them in the new movie. Save the final movie as "Self Contained" and you're done.

- *Note: If you wish to use this MoviePlayer edited movie for compression only, you can save the file as a "Reference" file instead of "Self Contained." Reference means that the final movie you save is just a bunch of pointers to your original source movies. The Reference movie is very small, but only works as long as you don't change any of the source movies. Be careful if you use this option.*

Complicated edits

For more complicated edits and effects, programs such as Adobe Premiere, Avid Cinema, or Strata's VideoShop may be required. These programs use a time-line based interface to allow you to put clips in order and use various transitions between the clips.

You can also do limited special effects with Premiere or VideoShop. Premiere and VideoShop have fairly steep learning curves but allow you to do many things. Premiere also has many plug-ins made by third parties to add special effects and transitions.

Avid Cinema is probably the easiest editing package to use, and has a tab-based interface that walks you through the various steps of story-boarding, capture, editing, and output. Hobbyists may do better with Cinema; professionals will probably want Premiere or VideoShop, or the software that comes with the higher end systems such as the Avid Media Composer.

Effects

For adding effects to your movie, you may use several different programs. Adobe AfterEffects lets you composite together various layers of video and add neat effects using its plug-ins. AfterEffects is a very powerful tool with a steep learning curve, but it is widely used to great effect. It is often called the “Photoshop” of the video world.

Other programs such as Strata’s MediaPaint and Fractal Design’s Painter 4.0 let you actually paint onto a movie. This is useful for many different effects. Some programs let you morph video, melt it, distort it, etc. If you want to do interesting things to video, you won’t have any trouble finding software to do it. However, most of this software is fairly expensive.

Editing Tips

Transitions. Avoid lots of elaborate transitions—aside from the fact that they often distract viewers from your movie, they don’t compress well and may make your final compressed video look very “chunky” during the change. Hard cuts are usually best, or quick cross-fades. Videos that zoom out from behind the first track, do a “page turn”, or wrap around a ball and then fly off the screen may look cool, but usually don’t compress well and should be used sparingly.

Save the file in the right format. Whatever you do to your video (edit, effects, etc.) make sure to save the edited file uncompressed. With QuickTime, just set the compression option to “None” or “Animation” with the quality slider on 100% (the Animation codec at 100% is a lossless, software-only format). This will make a very large file, but you won’t lose quality the way you will if you compress a movie multiple times.

You will not be able to play this movie smoothly at this point because it will have a very high data rate. Don’t worry—Step 4, Compression, will change that.

- ▶ *Note: If the large file size just won’t work for you, you can use the Photo JPEG codec at 100%. You will lose some quality, and in some scenes there may be JPEG artifacts, but this option will give you dramatically smaller files.*

Don’t compress the file with your editing package. Most editing packages offer basic compression output options. However, editing software does not offer complete compression process control. To achieve maximum compression quality, you should output an uncompressed file from your production/editing tool and then compress the final file with a compression tool (e.g. Media Cleaner Pro).

What about saving the video in my capture hardware format?

We don’t recommend saving the video in the hardware format of your capture card for three reasons:

- 1 Most capture systems use a lossy format such as JPEG. Every time you save the file, you lose quality. Multiple JPEG passes tend to add color noise and blockiness, especially around fine detail areas. Keep your saves to a minimum, and avoid using JPEG more than once.
- 2 Some capture cards have a hard time supporting multiple movies that use the hardware compression at the same time. Often these systems will crash if you try to open and play two movies at once. Saving a movie that originally uses the hardware codec can cause problems on some machines/configurations.

- 3 Finally, if you save a movie with a software-only codec, you can easily take it to a different machine for the slow process of compression. This way you don't tie up your expensive editing machine with compression. Since there is no dependency on the capture hardware, you are also less likely to run into crashes.

Archive the edited, uncompressed video. Always archive your final uncompressed video. DAT tapes work well for this because they provide large amounts of inexpensive storage. (They are slow, so do this overnight). By saving the original, uncompressed source, you can go back to it later and recompress it for a different size, frame-rate, data rate, etc. This keeps your future options open.

For example, a few years ago no one thought that putting their videos on the Internet would be an option. Now the Internet is full of video. Having the original, uncompressed video available allows you to go back later and make a new version for other uses with the maximum possible quality.

This is especially important if your original use was low data rate (1x CD-ROM, for example) and now you want to use the same video for a higher data rate (4x CD-ROM, for example). If you only have a 1x movie, there is nothing you can do to improve its quality up to a 4x rate (the data is simply gone in the compressed version). That's where your archived original comes to the rescue.

Summary

Editing is the fun step where you take your raw video and turn it into a movie. You can also add effects at this point. There are many different programs to edit and add effects. Choose your tools based on your needs and budget.

We recommend archiving the edited (but uncompressed) movie for unforeseen future use.

Compress

Up to this point you have been working with very large files (1-20 Mb per second). This step is where you take these huge files and make them small enough that you can play them from a CD-ROM, or over the Internet.

The tips in this section focus on Sorenson Video and other QuickTime specific tools used during compression such as the QDesign Music codec. Terran Interactive produces a line of compression control tools that enhance your compression capabilities. Together, these tools provide the best compression options available today.

Many people get by with other compression tools, including MovieShop and Premiere, but by themselves, these are inferior compression solutions. Media Cleaner Pro includes an Adobe Premiere export module which allows you to use Premiere for editing (which is its strength) and Media Cleaner for better results in your final compression. *For more information on using Media Cleaner to produce QuickTime movies, see "Enhanced data rate control with Cleaner 5" on page 52.*

Compression for CD-ROM

During the compression step, the original digital video file is dramatically reduced in size so that a CD-ROM drive can play it properly. Compression often ranges anywhere from 10:1 to 100:1.

Taking a signal that is originally 10 Mb and making it 200 Kb (50:1 compression) results in some image degradation. In order to maximize the image quality, it is critical that you compress the video as effectively as possible. Poor compression will make even the best video look terrible. *For compression guidelines, see "How Sorenson Video works" on page 12.*

CD-ROM data rates. A mid-range Windows machine can safely handle about 180 Kilobytes per second (KB/s) of movie data from a 2x CD-ROM. This means that your movie must be below 180 KB/s in order to play on the widest range of computers. If your movie's data rate goes above this, you may get jerky video, and the sound may break up. Your uncompressed video often has data rates in the 1-20 Mb per second range, which is obviously too high for CD-ROM.

However, just because the CD-ROM can transfer 180 KB/s doesn't mean that you compress at that rate. The final data rate you choose for compression depends on the video and audio codec used, not just the target CD-ROM speed. Lower data rates require less space on the CD-ROM and thus can accommodate more video. Some of the older audio and video codecs required a lot of data to look good. The Sorenson Video 3 and QDesign codecs require a much lower data rate. Where Cinepak and IMA required 180 KB/s, Sorenson Video and QDesign can look and sound as good, or better, at 70 KB/s.

Compression for the Internet

Trying to take a huge file and push it through the low-bandwidth Internet is even harder than trying to make it play properly on a CD-ROM. Data rates are often 1/10th to 1/100th the size of a CD-ROM. Needless to say, this makes compression absolutely critical; anything you can do to improve how well your movie compresses will help.

Internet data rates. The Internet has even lower bandwidth than a CD-ROM. Users are often connected with extremely slow connections and you must make your movies as small as possible so that people can view them. Data rates range from about 50 KB/s for fast connections down to only 1.5-2 KB/s for 28.8 modems. To produce good video at Internet rates requires Sorenson Video and QDesign Music or Qualcomm PureVoice codecs.

Compress

Summary

Compression reduces your huge video file to a size that will play properly from CD-ROM or the Internet. The Sorenson Video 3 and QDesign codecs produce superior quality at lower data rates than previous codec options and are the only choice for very low data rate Internet video.

Since compression sacrifices quality, it is important to use a dedicated compression tool, such as Terran Interactive's Media Cleaner Pro, to get the best results.

Distribute

After you have successfully completed the previous steps, you have a completed QuickTime movie, ready for distribution. Your movie may be the final product, or it may only be a piece of a larger project. However your movies fit into the final picture, there are two common channels for distributing QuickTime multimedia movies: CD-ROM and the Internet.

There are many tools available for both distribution methods. You may choose to acquire the tools and do the work yourself, or you may have others integrate your finished movies into a final product. No matter how you distribute your movies, it is always wise to test the process thoroughly to make sure the results are what you expect.

Contacting Technical Support

If you are unable to resolve a Sorenson Video question or problem, contact the Sorenson Media Technical Support at:

Email: support@sorenson.com

Web site: www.sorenson.com

Glossary

As with any book about technology, we use our share of acronyms and jargon. We provide this glossary as a quick reference of terms and concepts that may not be familiar to you. All terms are listed in alphabetical order.

Asymmetric

Unequal. Refers to the time spent encoding vs. decoding using Sorenson Video. Encoding can take much longer than decoding.

Bandwidth

The amount of data/second that can be delivered to your computer. A 56K modem has a bandwidth of 56 Kb/second.

Bidirectional frames

A bidirectional frame is a frame created by the compressor and inserted between intraframes and/or interframes. The compressor analyzes the frames before and after the bidirectional frame and then creates and inserts a frame based on the average quality of both.

Broadcast

A streaming option that sends a single stream that branches down all channels, regardless of whether a client is listening.

CD-ROM

Compact Disc—Read Only Memory.

Glossary

Chrominance

The perception of color.

Codec

A contraction for the terms Encoder/Decoder. A codec encodes data for efficient transmission and then decodes the received data for presentation.

Compression

The act of making a file or data stream smaller. Compression can be either lossy or lossless. Sorenson Video compression is lossy.

Decoding

Reconstructing an encoded file or data stream.

Encoding

Analyzing and compressing a file or data stream.

Firewall

A device used to keep uninvited guests from entering a private network.

FPS

Frames per second.

Frame

A single image, much like a photograph. NTSC video usually contains 30 frames per second.

HTTP

HyperText Transport Protocol. The standard protocol used to transfer information over the Internet.

Interframe

A temporally compressed frame (see temporal compression).

Internet

A decentralized, global network. Commonly known as the World Wide Web.

Intraframe

A spatially compressed frame (see spatial compression).

Intranet

A localized, private network based on the same technology as the Internet.

Kb

Kilobits. Used to measure the amount of data sent each second (Kb/s).

KB

KiloBytes. Used to measure the amount of data sent each second (KB/s). 1 KB(yte) = 8 Kb(its).

Keyframe

A spatially compressed frame used as the reference point for interframes.

LAN

Local Area Network

Lossless

A compression scheme where the reconstructed image is exactly the same as the original. No data is lost.

Lossy

A compression scheme where some of the less important or less visible data is discarded in order to make the image smaller. The reconstructed image is close to the original, but not exactly the same.

Luminance

Brightness of an image or object.

Masking

Masking lets you isolate the foremost part of your video so you can insert an image, movie or other video sequences as the background. This feature works similar to chroma-key.

Multicast

Delivering a single stream that branches to multiple recipients. Results in a single stream in the delivery pipe and greatly reduces network congestion.

NTSC

National Television Standards Committee. The NTSC defines the North American television standard.

PAL

Phase Alternating Line. The dominant European television standard.

QuickTime

Apple computer's multimedia delivery architecture. Sorenson Video is a QuickTime codec.

RTP

Realtime Transport Protocol. A data transport protocol defined to deliver live media capture to one or more clients at the same time. Requires an RTP server to capture, compress, packetize, and transmit the data over a network in real time. The transport protocol used by RTSP streaming.

RTSP

RealTime Streaming Protocol. The standard used to transmit stored media to one or more clients at the same time. Provides client controls for random access to the content stream. Requires an RTSP server. RTSP uses RTP as the transport protocol.

Spatial compression

Compression applied to a single frame, independent of any preceding frames. Often called an "intraframe".

Streaming

Playing a multimedia file as it downloads.

Temporal compression

A compression technique that compares a frame to the preceding frame and then transmits only the differences. Often called “interframe” compression.

UDP

User Datagram Protocol. The data transmission standard used by RTP to broadcast data over IP networks. UDP is designed for broadcast and thus lacks many of the error correction features of TCP. UDP is a “lossy” protocol, meaning that some data may be lost in transmission.

Unicast

Delivering a separate stream for each user. Results in multiple streams being delivered through a single pipe.

Vector

A 16x16 pixel block from a video frame.

Vector Quantization (VQ)

A compression algorithm that uses representative patterns to define an image and reconstruct it.

WAN

Wide Area Network.

YUV-12

A color encoding scheme composed of 8x8 pixel color blocks, used to save space when encoding graphics and video. For every 16 luminance samples (Y), there are only eight chrominance samples (U, V).

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