

About the Apple ProRes Codecs

The Apple ProRes codecs provide an excellent solution for the most demanding modern post-production workflows. Many of today's HD formats were developed under significant camcorder engineering constraints and therefore limit the full quality that can be carried in an HD signal. Other camera codecs preserve full quality but are too complex to achieve the software decoding speeds required for real-time editing. Uncompressed HD formats deliver the highest image quality, but the high-bandwidth, RAID-storage requirements of uncompressed HD video are daunting for most users' budgets.

The Apple ProRes codecs maintain the highest quality and performance while requiring much less expensive editing and storage hardware (compared to uncompressed video). The Apple ProRes codecs produce video that is indistinguishable from uncompressed HD video and needs less storage space than uncompressed SD video.

The Apple ProRes codecs were designed for great software flexibility and performance. No extra hardware is required for encoding or decoding. In particular, the Apple ProRes codecs have been designed to take advantage of multicore processors. The performance of Apple ProRes codecs scales—which means that the decoding time per frame goes down—as the number of processors increases. When the system spends less time decoding each frame, it has time for more real-time effects processing.

The Apple ProRes family of codecs provides these advantages:

- *Quality indistinguishable from that of the most pristine sources:* Maintains superb quality even after multiple encoding/decoding generations.
- *Mastering-quality 4:4:4:4 RGBA:* Provides a lossless alpha channel with real-time playback (Apple ProRes 4444 only). Mastering-quality 4:4:4 Y'CbCr color and 4:2:2 Y'CbCr color are also available.
- *The quality of uncompressed HD at data and storage rates lower than those of uncompressed SD:* Provides real-time editing performance comparable to or better than that of any other HD codecs in Final Cut Pro.
- *Apple ProRes encoding at any frame size—SD, HD, 2K, 4K, or other:* Apple ProRes codecs can also be encoded into nonstandard frame sizes, but nonstandard frame sizes are not supported for real-time playback in Final Cut Pro.
- *Variable bit rate (VBR) encoding:* "Smart" encoding analyzes the image. Efficiency is increased because excess bits are not wasted on simple frames.
- *10-bit sample depth:* Preserves subtle gradients of 10-bit sources (sunsets, graphics, and the like) with no visible banding artifacts. When you import a file using an Apple ProRes codec, you don't have to first determine whether the file is an 8-bit or 10-bit file. Apple ProRes codecs always preserve the bit depth of your original source files.
- *I-frame-only (intraframe) encoding:* Ensures consistent quality in every frame, with no artifacts from complex motion, and speeds up editing.
- *Fast encoding and decoding:* Delivers high-quality, real-time playback and faster rendering times.
- *Equipment affordability:* Because of low bit rates, you can edit more streams with more real-time effects on slower drives, or have more users accessing the same media over shared storage devices.
- *Workflow options for any video format that does not have native Final Cut Pro support:* The Apple ProRes format provides an effective workflow for projects involving multiple acquisition formats when you want to standardize on a single codec.
- *Better rendering for native editing:* Can be used to render long-GOP MPEG-2 formats (such as HDV and XDCAM HD) to speed up editing and avoid MPEG-2 reencoding artifacts before output.

Types of Apple ProRes Codecs

The Apple ProRes format comes in five versions: Apple ProRes 4444, Apple ProRes 422 (HQ), Apple ProRes 422, Apple ProRes 422 (LT), and Apple ProRes 422 (Proxy). The following list describes the features of each version. For a complete comparison of the relative data rates of the Apple ProRes codecs, see [Apple ProRes Format Specifications](#).

Apple ProRes 4444

The Apple ProRes 4444 codec offers the utmost possible quality for 4:4:4 sources and for workflows involving alpha channels. It includes the following features:

- Full-resolution, mastering-quality 4:4:4:4 RGBA color (an online-quality codec for editing and finishing 4:4:4 material, such as that originating from Sony HDCAM SR or digital cinema cameras such as RED ONE, Thomson Viper FilmStream, and Panavision Genesis cameras). The R, G, and B channels are lightly compressed, with an emphasis on being perceptually indistinguishable from the original material.
- Lossless alpha channel with real-time playback
- High-quality solution for storing and exchanging motion graphics and composites
- For 4:4:4 sources, a data rate that is roughly 50 percent higher than the data rate of Apple ProRes 422 (HQ)
- Direct encoding of, and decoding to, RGB pixel formats
- Support for any resolution, including SD, HD, 2K, 4K, and other resolutions
- A Gamma Correction setting in the codec's advanced compression settings pane, which allows you to disable the 1.8 to 2.2 gamma adjustment that can occur if RGB material at 2.2 gamma is misinterpreted as 1.8. This setting is also available with the Apple ProRes 422 codec.

Apple ProRes 422 (HQ)

The Apple ProRes 422 (HQ) codec offers the utmost possible quality for 4:2:2 or 4:2:0 sources (without an alpha channel) and provides the following:

- Target data rate of approximately 220 Mbps (1920 x 1080 at 60i)
- Higher quality than Apple ProRes 422

Apple ProRes 422

The Apple ProRes 422 codec provides the following:

- Target data rate of approximately 145 Mbps (1920 x 1080 at 60i)
- Higher quality than Apple ProRes 422 (LT)

Apple ProRes 422 (LT)

The Apple ProRes 422 (LT) codec provides the following:

- Roughly 70 percent of the data rate of Apple ProRes 422 (thus, smaller file sizes than Apple ProRes 422)
- Higher quality than Apple ProRes 422 (Proxy)

Apple ProRes 422 (Proxy)

The Apple ProRes 422 (Proxy) codec is intended for use in offline workflows and provides the following:

- Roughly 30 percent of the data rate of Apple ProRes 422
- High-quality offline editing at the original frame size, frame rate, and aspect ratio
- High-quality edit proxy for Final Cut Server

Maximizing Performance by Adjusting Real-Time Playback Quality

After you have captured to an Apple ProRes codec or transcoded from another format to an Apple ProRes codec, you can take advantage of the exceptional real-time playback performance of Apple ProRes files. With RT Extreme, you can set a project's sequence for real-time playback at different levels of video quality.

At high-quality, real-time playback settings, Final Cut Pro displays video and effects at full resolution. Medium-quality playback shows video at half its full dimensions, to reserve processor power for more video streams and effects. The Apple ProRes format has been engineered not only for excellent decoding speed at full-resolution playback, but moreover to provide exceptionally fast speed at half resolution. This latter mode provides tremendous value for practical editing productivity.

To adjust real-time video playback quality to medium quality

1. Make sure a sequence is open in the Timeline.
2. In the RT pop-up menu, choose Medium in the Playback Video Quality section.

Note: Additionally, if you are working with native file formats with very large frame sizes, choose Unlimited RT from the RT pop-up menu. For more information, see the *Final Cut Pro 7 User Manual*.

Sample Apple ProRes Workflows

The following sections provide examples of workflows that use Apple ProRes codecs at their core.

Mastering REDCODE Projects

After final grading in Color, you can render to the Apple ProRes 4444 codec and send the project back to Final Cut Pro for conforming and output. REDCODE is a 12-bit, 4:4:4, full-color format. By grading the native R3D files with float processing and then rendering to a 4:4:4 format for editing, you retain the maximum possible quality.

For more information, see [Working with REDCODE Media](#).

Capturing Directly to the Apple ProRes 4444 Codec

You can capture from an HDCAM SR deck via dual-link 4:4:4 HD-SDI directly to the Apple ProRes 4444 codec, retaining full color information.

This workflow could include material shot on the Panavision Genesis and Arriflex D-20/D-21 cameras.

Mastering DPX or Cineon Digital Negative Projects

This could include film-scan workflows or digital cinema cameras (such as the Thomson Viper FilmStream and the Vision Research Phantom) that deliver DPX image sequences for the post-production pipeline. Apple ProRes can be the finishing and mastering format, or it can be used as a very high-quality offline format for digital intermediate workflows that will be finished in DPX for film output.

Transcoding Directly to an Apple ProRes Codec on Ingest

Ingesting or transcoding directly to an Apple ProRes codec is particularly convenient if your project involves multiple camera formats and you want to standardize on a single codec for post-production. This includes retaining the quality in 4:4:4 digital cinema formats by transcoding directly to the Apple ProRes 4444 codec.

Compositing and Visual Effects Projects

The 10-bit, 4:4:4 color space plus an alpha channel is especially useful for compositing and effects projects in both Final Cut Pro and Motion. After the motion graphics (with or without an alpha channel) are created in Motion, they can be preserved in the Apple ProRes 4444 format all the way through to the finish. For more information about preserving the alpha channel in Final Cut Pro, see "Sequence Settings and Presets" in the *Final Cut Pro 7 User Manual*. For more information about Motion, see the *Motion User Manual*.

Offline Editing with Apple ProRes Codecs

The offline/online workflow allows you to use temporary, low-quality copies of your footage during editing and then finish your project with full-resolution media. Lower-resolution media files require less hard disk space and less computing power to process transitions and effects. This means you can edit on an inexpensive computer or a portable computer and then finish at full resolution on another system.

Depending on your project and your budget, you could use any of the Apple ProRes codecs for offline editing. On the high end, you might use Apple ProRes 4444 as a very high-quality offline codec for digital intermediate workflows that will be finished in DPX for film output. For a typical HD or SD video project, you can get high quality and superb playback performance with Apple ProRes 422 (LT) or Apple ProRes 422 (Proxy) as your offline format.

All Apple ProRes codecs maintain the source frame size and aspect ratio throughout the offline and online editing phases.

Here are possible offline scenarios using the Apple ProRes format:

- *Ingest media as Apple ProRes files:* In this workflow, you transfer the media to an Apple ProRes codec using the Log and Transfer window, complete the offline edit in the Apple ProRes codec, and then retransfer from the source media using an online-quality Apple ProRes codec (or a different format) to create the master version of the project.
- *Transcode media to Apple ProRes files:* In this workflow, you transcode the media files from an existing Final Cut Pro project to an Apple ProRes codec using the Media Manager in Final Cut Pro (or using Compressor or Final Cut Server), complete the offline edit in the Apple ProRes codec, use the Media Manager to create a master version of the project, and remaster the project in the final media format.

Using Apple ProRes Codecs in Native Workflows

If you are editing HDV or Sony XDCAM formats natively, you can choose to create render files using either the native MPEG-2 codec of your sequence or an Apple ProRes codec.

For more information, see “Rendering and Video Processing Settings” in the *Final Cut Pro 7 User Manual*.

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Choosing the Appropriate Apple ProRes Codec

The following table matches specific camera, recording, or film-scan formats with suggested workflows and corresponding versions of Apple ProRes.

Acquisition format	Workflow	Most appropriate Apple ProRes codec
REDCODE	REDCODE workflows See Native REDCODE Editing Workflow and Transcoded REDCODE Editing Workflow.	Apple ProRes 4444
HDCAM SR REDCODE	Projects recorded in 4:4:4 RGB mode and transcoded directly to the Apple ProRes 4444 codec on ingest	Apple ProRes 4444
DPX image sequences	Projects that generate DPX image sequences, including those using film-scan workflows or digital cinema cameras	Apple ProRes 4444
Sony HDCAM SR	Projects recorded on Sony HDCAM SR in 4:4:4 RGB or 10-bit 4:2:2 color mode	Apple ProRes 4444 or Apple ProRes 422 (HQ)
DVCPRO HD	Online master phase of projects that don't use effects or compositing	Apple ProRes 422 (HQ) or Apple ProRes 422
AVC-Intra	Online master phase of projects that don't use effects or compositing See Transcoded AVC-Intra Editing Workflow.	Apple ProRes 422 (HQ) or Apple ProRes 422
HDV	Online master phase of projects with heavy effects	Apple ProRes 422 (HQ) or Apple ProRes 422
Any format	Motion graphics or compositing projects that require an alpha channel	Apple ProRes 4444
Any format	Workflows that involve offline editing on a MacBook Pro	Apple ProRes 422 (Proxy)
Multiple camera formats	Projects requiring standardization on a single codec for post-production	A single Apple ProRes codec (depending on source and delivery formats)

Apple ProRes Format Specifications

With the Apple ProRes format, you can work in a wide variety of frame sizes, frame rates, bit depths, and even color sample ratios.

Frame Dimensions Supported in Final Cut Pro with Real-Time Playback

Although the Apple ProRes format itself supports virtually any frame size, the Final Cut Pro RT Extreme real-time effects architecture supports the following Apple ProRes frame sizes only:

- 720 x 480
- 720 x 486
- 720 x 576
- 960 x 720
- 1280 x 720
- 1280 x 1080
- 1440 x 1080
- 1920 x 1080
- 1024 x 512
- 1024 x 576
- 2048 x 1024
- 2048 x 1080 (Apple ProRes 4444 only)
- 2048 x 1152
- 2048 x 1556 (Apple ProRes 4444 only)

Scanning Method

The Apple ProRes format supports both interlaced and progressive scan images and preserves the scanning method used in the source material.

Color Recording Method

The Apple ProRes format supports the following digital video signals:

- RGB
- 4:2:2 Y'C_BC_R
- 4:4:4 Y'C_BC_R

Data Rates

The actual data rate of Apple ProRes codecs depends on the dimensions, frame rate, image complexity, and quality setting you are using.

The Apple ProRes format has a target data size for every frame, regardless of complexity, but allows frames to fall short of that target if they are simple (if they cannot benefit in quality from using more bits). Such a shortfall is not reclaimed for other frames; instead, it just produces a smaller overall file.

The following table shows several sample data rates. The Apple ProRes codecs are designed to target the data rates shown. Because most sequences contain simple frames, actual bit rates are typically 5 to 10 percent lower than these targets.

Frame dimensions	Frame rate	Apple ProRes 4444 data rate	Apple ProRes 422 (HQ) data rate	Apple ProRes 422 data rate	Apple ProRes 422 (LT) data rate	Apple ProRes 422 (Proxy) data rate
720 x 486	23.98 fps	75 Mbps	50 Mbps	34 Mbps	23 Mbps	10 Mbps
720 x 486	25 fps	79 Mbps	52 Mbps	35 Mbps	24 Mbps	10 Mbps
720 x 486	29.97 fps	94 Mbps	63 Mbps	42 Mbps	29 Mbps	12 Mbps
720 x 576	23.98 fps	88 Mbps	59 Mbps	39 Mbps	27 Mbps	12 Mbps
720 x 576	25 fps	92 Mbps	61 Mbps	41 Mbps	28 Mbps	12 Mbps
720 x 576	29.97 fps	110 Mbps	73 Mbps	49 Mbps	34 Mbps	15 Mbps
960 x 720	23.98 fps	113 Mbps	75 Mbps	50 Mbps	35 Mbps	15 Mbps
960 x 720	25 fps	118 Mbps	79 Mbps	52 Mbps	36 Mbps	16 Mbps
960 x 720	29.97 fps	141 Mbps	94 Mbps	63 Mbps	44 Mbps	19 Mbps
1280 x 720	23.98 fps	132 Mbps	88 Mbps	59 Mbps	41 Mbps	18 Mbps
1280 x 720	25 fps	138 Mbps	92 Mbps	61 Mbps	42 Mbps	19 Mbps
1280 x 720	29.97 fps	165 Mbps	110 Mbps	73 Mbps	51 Mbps	23 Mbps
1440 x 1080	23.98 fps	226 Mbps	151 Mbps	101 Mbps	70 Mbps	31 Mbps
1440 x 1080	25 fps	236 Mbps	157 Mbps	105 Mbps	73 Mbps	32 Mbps
1440 x 1080	29.97 fps	283 Mbps	189 Mbps	126 Mbps	87 Mbps	38 Mbps
1920 x 1080	23.98 fps	264 Mbps	176 Mbps	117 Mbps	82 Mbps	36 Mbps
1920 x 1080	25 fps	275 Mbps	184 Mbps	122 Mbps	85 Mbps	38 Mbps
1920 x 1080	29.97 fps	330 Mbps	220 Mbps	147 Mbps	102 Mbps	45 Mbps
2048 x 1152	23.98 fps	302 Mbps	201 Mbps	134 Mbps	93 Mbps	41 Mbps
2048 x 1152	25 fps	315 Mbps	210 Mbps	140 Mbps	97 Mbps	43 Mbps
2048 x 1152	29.97 fps	377 Mbps	251 Mbps	168 Mbps	116 Mbps	52 Mbps

Apple ProRes Tips

This section lists some practical tips for working with Apple ProRes codecs.

Gamma Correction

Apple ProRes codecs have a native gamma of 2.2. The Gamma Correction setting in the advanced compression settings pane allows you to disable the automatic 1.8 to 2.2 gamma adjustment that can occur if RGB material at 2.2 gamma is misinterpreted as 1.8. In some cases this gamma adjustment is not desirable (for example, if the source image is RGB 2.2, or if the encoded Apple ProRes file is meant to be used in another RGB-based application).

- *Automatic*: Select the Automatic setting to have the Apple ProRes codec convert RGB 1.8 gamma source media files to 2.2 gamma.
- *None*: Select the None setting to disable the adjustment of 1.8 gamma to 2.2 gamma.

Apple ProRes 4444 Files with Alpha Channel and the Video Render Status Bar

When you import an Apple ProRes 4444 file with an embedded alpha channel, Final Cut Pro detects the alpha channel and sets the Alpha value to either Black or Straight (instead of None/Ignore). If you add the clip to a matching Apple ProRes 4444 sequence, the video render status bar in the Timeline may change color accordingly.