

Adrienne Electronics' BOX, Final Cut Pro, and video file servers.

The worst thing about post-production is capturing video. It consumes hours of unproductive time. It ties up an expensive HD deck and often an entire edit suite. Until recently, it was a necessary evil.

Przyborski Productions Inc. (www.przyborski.com) is a Pittsburgh based company that produces network and regional TV commercials for clients and agencies across the country. They've been using a cost-effective, creative HDTV workflow that solves problems and increases efficiency.

In 2006, director/cinematographer, Glenn Przyborski decided to build a portable video file server to use in-studio and on-location. The goal was to capture the camera's non-compressed HD-SDI video with embedded audio, plus time code. All post-production would take place from the captured files. The camcorder's videocassette recording would be relegated to the role of archiving the project. For everything to work, the captured files and corresponding videocassette recordings had to have exactly the same time code.

Other benefits of recording directly to a video file server are that you're typically recording non-compressed digital video instead of capturing after the encode-decode cycle of compressed tape. On-set, you also have perfect quality, unlimited playbacks of takes for screening and reviewing by you and your clients. (Never allow your camera's master recording to be rewound and played back for simple screening purposes... it's a recipe for disaster!)

Przyborski took a slightly older, dual processor, 2.5Ghz G5, added 4 gigs of ram, a Blackmagic Designs' DeckLink HD Pro video card, and a Highpoint "RocketRAID" 2220 SATA controller card. (Many Mac users aren't aware that Highpoint Technologies offers several high performance, SATA RAID cards for OS-X. Note that if you were installing a video card and RAID controller card in a Quad G5 or the latest Intel Macs, you would purchase PCI-e versions.)

A custom designed, slide-in disk drive case was fabricated to hold 8, 3.5", 500GB, SATA drives, 3 quiet fans, and a power supply. At the time, every off-the-shelf RAID drive case that could handle 8 SATA drives was too big and too heavy. The latest generation of 3.0Gb/s SATA drives are very fast and inexpensive.

The eight SATA drives were attached to the PCI-X controller using flexible, 1 meter, standard SATA cables. Since the RocketRAID 2220 card has all of its SATA connectors located inside the Mac, the 8 cables were neatly plugged into the card, then passed through an adjacent card slot opening on the rear of the computer. The eight thin SATA cables then plugged directly into each of the eight disk drives. The custom case holding the drives was attached to the side of the G5 to prevent any movement that might affect the exposed SATA cables. Both the computer and RAID assembly sit on 2 inches of dense foam to cushion the shock of transportation and on-set movement.

Time code has been around a long while. However, when it comes to directly capturing live SDI or HD-SDI video from a camera, a major problem pops up. Video cards from Blackmagic and AJA are designed to control a videotape machine via a DB-9, Sony protocol, RS-422 connection. Time code from the tape deck to the video card arrives as part of this serial data. At present, none of the internal SDI and HD-SDI video capture cards have a dedicated time code input.

RS-422 is a bi-directional data connection. This means that there's constant communication, or handshaking between the video card and the tape deck it's controlling. For example, the card issues a command to initiate playback. The recorder responds that the command was received and that the deck is now in the play mode. Hundreds of communications take place between the deck and the video card every second.

Broadcast camcorders don't use RS-422. Instead, they usually output time code on a BNC connector. An interface was necessary to convert the camera's time code signal to RS-422 data. Furthermore, this converted RS-422 signal would have to emulate a Sony tape deck. The interface would have to initiate and respond to bi-directional communications with the video capture card. Another unique requirement for the interface is that it be able to seamlessly and automatically work with time code at 23.976fps and 29.97fps. Without such an interface, the time code on the videocassette would not be the same as the time code on the captured scenes.

The Adrienne Electronics' BOX is a unique, cost effective solution to the live time code recording dilemma. The unit plugs into the 9 pin, RS-422 connection from the video card. The time code cable from the camcorder plugs into a BNC connector on the BOX. . The small unit gets it's power from one of the Mac's USB sockets.

Setting up Final Cut Pro to capture non-compressed video and time code from your camera is pretty simple and straight forward. For this example, let's assume your camera is a Sony F900R and you plan to shoot 1080P at 23.976 fps. A BNC cable is connected between the camera's HD-SDI output and the HD-SDI input on the video capture card. A second BNC cable goes from the camera's time code output connector to the BOX 's time code input.

The camera's time code generator should be set to "record run" and a preset time code number loaded into the generator. Usually, the hour digits of time code correspond to the cassette number. For example, videocassette #8 on a project would start with a time code of 08:00:00:00. If "free run" instead of "record run" were to be selected, the videocassette would not be able to be cued and captured under editor control unless there was at least 3 seconds of continuous time code before the desired in point.



(Przyborski's assistant working the FCP system for video assist/master capture.)



(Close up of the Adrienne Electronics 'AEC- BOX-2' time code-to-RS422 module)



(Przyborski's Mac/FCP video capture rig ready for transport)



(Glenn Przyborski at a commercial shoot using his Sony HD video camera.)

Setting up Final Cut Pro V5.1.4 for Live to Disk Recording

(please reference the FCP screen captures at the end of this writing)

In Final Cut Pro, under the Audio/Video Settings menu, a "sequence preset" of "1080P 23.98 - 10bit" is selected.

"1080P 23.98 - 10bit" is also entered into the Capture Preset heading.

For the "Device Control Preset" you must click on "Non-Controllable Device." Then, by attempting to edit this default setting, Final Cut will create a copy of the menu item. In the copy, make sure "Protocol" is set to Sony RS-422 and "Source" is LTC or longitudinal time code. For our example, "Rate" should be set to 23.98.

The 4th and final item in the main Audio/Video Settings menu is "Video Playback". You would typically enter the ideal or best quality format your screening monitor is capable of displaying. We use a setting of "1080P 23.976Hz - 10Bit". Many monitors can't deal with a less than 30P frame rate. In that case, the video card has to add 3-2 pulldown to achieve a 60Hz refresh rate.

Let's assume you have everything hooked up, powered, and your FCP preferences are set as described. We'll also assume that your RAID array is working, capable of handling the data speed requirements of non-compressed video, and the RAID array is set to be FCP's video and audio scratch disk. (Remember, all SDI signals are non-compressed. HD-SDI data rate is about 185 MB/sec. The data rate for standard definition SDI is about 34 MB/sec.)

To begin capturing live video, you first open a 1080p / 23.976 sequence. Next click on "Log and Capture." The capture panel will open and you should see live video from your camera. If you don't, something is wrong in your preferences or the camera isn't outputting a video signal on its SDI output. With a blank tape in the camera, start the camera recording. You should see live video and the correct, incrementing time code in the capture window. Click "Capture Now" to begin recording to your RAID array. Press the "ESC" key on your keyboard to stop recording.

To create valid video files, you must first start recording on your camera's tape, then click the "Capture Now" button. **VERY IMPORTANT:** You must stop recording on the RAID before you stop recording to the camera's tape. If you stop the camcorder first, Final Cut Pro will not create a valid QuickTime file. Failure to do this will not affect your camera's recording, but will result in unusable files on the RAID array.

Over the past 10 months, the G5 computer, RAID assembly and AEC time code to RS-422 box have proven to be very reliable during heavy use.

After the first 2 location jobs, very bright LED "pilot lights" were added to both the computer and the RAID assembly to warn that they were operating. (In bright sunlight, you can't tell if a Macintosh is turned on with its stylized, tiny white LED.)

Also added was an inexpensive, uninterruptible power source that is capable of running the computer and RAID array for 5 to 7 minutes if the power cord is accidentally unplugged.

Some additional production tips:

For on-set and location client monitoring, we use a Dell 24 inch, 1920x1200 "Ultra Sharp" 2407WFP LCD monitor attached to a Blackmagic Designs' HD-Link HD-SDI to DVI interface. This Dell monitor has a lag of only 6ms and will properly display the 24P video without the need to add 3-2 pulldown, The HD-Link also allows you to calibrate the monitor's color settings so it can pretty well match the reference monitor in your edit suite. It's not perfect, but it's more than adequate for on-location work. Both the LCD monitor and the HD-Link can be purchased for about \$1,000. If you order this monitor, make sure to also purchase the Dell "Sound Bar" which is a small amplifier and speaker system that attaches below the monitor. Dell only charges \$30 for this accessory that steals its power from the LCD monitor. You then plug the audio input of the "Sound Bar" to the analog audio output of the HD-Link. Remember, the SDI or HD-SDI signal from the camera and from your video card contains embedded audio.

Make sure to establish a file naming procedure when capturing to a video file server. We've adopted the following format: 3 alphanumeric letters for the client, a dash, 3 numbers to represent the script's assigned scene number, a second dash, then "TK01". Final Cut will automatically increment the take numbers each time capture now is pressed. The complete file name of an actual scene from a recent AutoZone commercial was, "AZO-106a-TK07". The "a" in the file name indicated an alternate version of scene 106. The script person writes this file name next to the script notes for easy identification during the edit.

With consistent file naming, a director can easily locate and playback a specific take. It's also easy to quickly put your best takes on a timeline then playback a rough edited sequence while your crew is setting and lighting the next scene.

Frame rates can be confusing. 24P usually refers to 23.976 fps. Different camera manufacturers and software makers often round the number 23.976 to 23.98 even though it's actually 23.976. 30P usually means 29.97 fps. If that isn't confusing enough, many cameras that shoot at 24P record and output their video and time code at 29.97. The popular Panasonic SDX-900 can shoot at 24P, but the camera adds 3-2 pulldown to the video signal before it's recorded to tape or output. The result is NTSC compatible video and time code that must be captured to a 29.97 timeline.

29.97 and 23.976 time code are two different formats that are not compatible with each other. If you're shooting with a Sony Cine-Alta HD-Cam camera and you plan to switch between 29.97 and 23.976, you should switch tapes at the time of the speed change. You will also need a different sequence and different capture presets in Final Cut Pro. FCP will not allow you to capture video 29.97 video and time code with 23.976 settings.

After a shoot is complete, Przyborski edits on a different FCP based edit system. Using Apple's "Compressor" application, we create HD compressed files in the 1080p DVC-Pro format. Compressor, also located on the file server, copies then compresses each file assigning a suffix to the original file names. As in the earlier example, we have the non-compressed video file, "AZO-106a-TK07" and a new, compressed version for offline editing, "AZO-106a-TK07-DVCHD."

Compressor lets you create a "droplet" that does all the work. You simply select your original captured video files and drag them to the droplet. Within a few seconds, compressor is hard at work creating new offline versions that are a fraction of the original file size. The video file server creates these files without any operator intervention. During the offline edit, the compressed video looks great and most clients aren't aware that they're not watching the original HD. After the offline is approved, it's easy to conform the non-compressed video since the original files have exactly the same time code and most of the same file name.

The following screen grabs are from FCP 5.1.4 using a Blackmagic Designs' Decklink HD Pro video card and Decklink version 6.0 software. Camera is a Sony F900R at 1080P @ 23.976 fps.

Please note that the author of this article, Glenn Przyborski is an award winning, director/ cinematographer . Przyborski is also an inventor with patents in the field of 24P video. Those patents are currently licensed to Sony, Panasonic, Canon and others. His website is www.przyborski.com.

Note: These Final Cut Pro settings are used to capture, non-compressed, 1080x1920, HD video at 23.976fps to a RAID array named "SATA-Raid".

PowerMac 2.5Ghz Dual Processor w/ 3.5GB ram
OS-X 10.4.9
QuicktimePro version 7.1.5
FCP version 5.1.4
Decklink software version 6.0
Video Capture Card: Blackmagic Designs! Decklink HD Pro PCI-X
RAID Controller Card: Highpoint RocketRAID 2220
RAID array consists of 8, 500GB, SATA drives in external enclosure
LTC camera TC to Decklink: Adrienne Electronics' AEC- BOX
Camera: Sony F900R @ 23.976fps with HSDI output & TC output

User Preferences

General | Editing | Labels | Timeline Options | Render Control | Audio Outputs

Levels of Undo: actions

List Recent Clips: entries

Real-time Audio Mixing: tracks

Audio Playback Quality:

Limit real-time video to: MB/s

- Show Tooltips
- Bring all windows to the front on activation
- Open last project on application launch
- Autosave Vault

Save a copy every: minutes

Keep at most: copies per project

Maximum of: projects

Prompt for settings on New Project

Prompt for settings on New Sequence

Sync audio capture to video source if present

Report dropped frames during playback

Abort ETT/PTV on dropped frames

Abort capture on dropped frames

On timecode break:

Warn when importing non-optimized media

Browser Text Size:

Auto Render

Start Render after: minutes

Render:

Render RT Segments

Cancel

OK

System Settings

Scratch Disks Search Folders Memory & Cache Playback Control External Editors Effect Handling

Video Audio Video Audio
Capture Capture Render Render

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Clear	Set...	1.9 TB on SATA-Raid
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Clear	Set...	<None Set>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Clear	Set...	<None Set>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Clear	Set...	<None Set>

Capture Audio and Video to Separate Files

Waveform Cache: 49.7 GB on OS-Xe

Thumbnail Cache: 49.7 GB on OS-Xe

Autosave Vault: 49.7 GB on OS-Xe

Minimum Allowable Free Space On Scratch Disks: MB

Limit Capture/Export File Segment Size To: MB

Limit Capture Now To: Minutes

Cancel

OK

System Settings

Scratch Disks

Search Folders

Memory & Cache

Playback Control

External Editors

Effect Handling

Playback

RT: Safe

Play Base Layer Only (if render needed)

Video Quality: Dynamic

Beep When Playing Unrendered Audio

Frame Rate: Dynamic

Scrub High Quality

Pulldown Pattern: 2:3:2:3

Multiclip Playback

Gamma Correction: Accurate

Frame Offset: 4

Note: The video quality and pulldown capabilities for a particular sequence are based on system performance. Check the RT popup in the Timeline for the capabilities of a particular sequence.

Record

Full Quality

Cancel

OK

Audio/Video Settings

Summary

Sequence Presets

Capture Presets

Device Control Presets

A/V Devices

Sequence Preset: Blackmagic HDTV 1080p 23.98 – 10 Bit

Use this setting when editing with HD at 1080p/23.98 in 10 Bit

Capture Preset: Blackmagic HDTV 1080p 23.98 – 10 Bit

Use this setting when editing with HD at 1080p/23.98 in 10 Bit

Device Control Preset: 23.98fps camera capture

This Device is not able to be controlled.

Video Playback: Blackmagic HDTV 1080p 23.976Hz – 10 Bit (1920 x 1080)

Audio Playback: DeckLink Audio

Create Easy Setup...

Cancel

OK

Sequence Preset Editor

Name: **Blackmagic HDTV 1080p 23.98 - 10 Bit**

Description: Use this setting when editing with HD at 1080p/23.98 in 10 Bit

General **Video Processing**

Frame Size:

Width	Height	Aspect Ratio
1920	1080	HDTV 1080i (16:9)

Pixel Aspect Ratio: **Square** Anamorphic 16:9

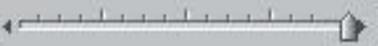
Field Dominance: **None**

Editing Timebase: **23.98**

Timecode Rate: **Same As Editing Timebase**

QuickTime Video Settings

Compressor: **Uncompressed 10-b...**

Quality:  **100 %**

Advanced...

Audio Settings

Rate: **48 kHz**

Depth: **16-bit**

Config: **Default**

Cancel

OK

Sequence Preset Editor

Name: Blackmagic HDTV 1080p 23.98 - 10 Bit

Description: Use this setting when editing with HD at 1080p/23.98 in 10 Bit

General Video Processing

- Always Render in RGB
- Render in 8-bit YUV
- Render 10-bit material in high-precision YUV
- Render all YUV material in high-precision YUV

Codecs which do not support YCbCr (also known as YUV) can only use RGB rendering; RGB rendering may be chosen for YUV-capable codecs, but may cause intensity or color shifts in rendered material.

High-precision YUV rendering provides higher quality results when applying multiple effects, or when the original material had more than 8 bits of precision, but takes longer to render.

Process Maximum White as: White

This selects how RGB colors are mapped into YCrCb image processing. This option can be set to match cameras which produce "brighter than standard" white (also known as super-white).

Motion Filtering Quality: Normal

This selects the filtering quality used when rendering motion tab motion effects.

Cancel

OK

Capture Preset Editor

Name: **Blackmagic HDTV 1080p 23.98 - 10 Bit**

Description: Use this setting when editing with HD at 1080p/23.98 in 10 Bit

Frame Size:

Width	Height	Aspect Ratio
1920	x 1080	HDTV 1080i (16:9)

 Anamorphic 16:9

QuickTime Video Settings

Digitizer: Blackmagic HDTV 1080 Compressor: Uncompressed 10-bit 4:2:2
Input: Blackmagic HDTV 1080p 23... Quality: 100 %
FPS: 23.98 (Custom)
 Limit Data Rate 0 K Advanced...

QuickTime Audio Settings

Device: DeckLink Audio
Input: DeckLink Audio Format: 48.000 kHz 24-bit 12-chan

- Capture Card Supports Simultaneous Play Through and Capture
- Remove Advanced Pulldown and/or Duplicate Frames from FireWire sources
- High-Quality Video Play Through

Cancel

OK

Device Control Preset Editor

Name: 23.98fps camera capture

Description: This Device is not able to be controlled.

Protocol: Sony RS-422

Audio Mapping: 2 Channels

Time Source: LTC

Port: RS422 Deck Control

Frame Rate: 23.98

Default Timecode: Drop Frame

Use Deck Search Mechanism

Capture Offset: 0

Pre-roll: 1 seconds

Handle Size: 00:00:00:00

Post-roll: 1 seconds

Playback Offset: 00:00:00

Auto Record and PTV after: 3 seconds

Cancel

OK

Device Control Preset Editor

Name: 29.97fps camera capture

Description: This Device is not able to be controlled.

Protocol: Sony RS-422

Audio Mapping: 2 Channels

Time Source: LTC

Port: RS422 Deck Control

Frame Rate: 29.97

Default Timecode: Drop Frame

Use Deck Search Mechanism

Capture Offset: 0

Handle Size: 00:00:00:00

Playback Offset: 00:00:00

Pre-roll: 3 seconds

Post-roll: 3 seconds

Auto Record and PTV after: 3 seconds

Cancel

OK

Audio/Video Settings

Summary

Sequence Presets

Capture Presets

Device Control Presets

A/V Devices

Playback Output

Video: Blackmagic HDTV 1080p 23.976Hz - 10 Bit

Options...

Mirror on desktop

Audio: DeckLink Audio

Options...

Different Output for Edit to Tape/Print to Video

Video: Blackmagic HDTV 1080p 23.976Hz - 10 Bit

Options...

Mirror on desktop

Audio: Default

Options...

- Do not show External A/V Device Warning when device not found on launch
- Do not show warning when audio outputs are greater than audio device channels

Cancel

OK

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