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HDV Workflow

JVC HDV and Sony HDV Workflow Using the
AJA KonaLH or KonaLHe with Final Cut Pro 5



Introduction

With the introduction of the HDV format, a broader era of HD acquisition has grown from the portable camcorder sized devices that could record compressed HD on inexpensive MiniDV tapes. However, akin to the beginning of the DV era in the late 1990s, this format is still early in its development and deployment. Though support for the format has grown quickly by comparison to its digital forerunner—DV, the format's very structure has proven to be somewhat problematic in a conventional post-production workflow.

The Format

What makes HDV such an amazing format is that it manages to capture HD images via MPEG2 compression and allow for recording the signal to a MiniDV tape (thankfully a tape format already ubiquitous in the marketplace among all major camera manufacturers and tape stock providers.) This MPEG2 compression is similar to a DVD (although DVD is a program stream vs. HDV's transport stream and HDV uses a constant bit rate whereas DVDs use variable bit rates).

The issue for post production is that the HDV transport stream is based around a long-GOP structure (group of pictures) which produces images based on information over a section of time, via I, P and B frames; Intraframes, predicted frames and bi-directional frames. Formats that do not use this scheme treat frames as individual units, as in the progressive formats where a frame truly is a frame, or as interlaced frames where two fields create the image. Sometimes we refer to these formats in contrast to MPEG formats, as I-frame formats where frames can be easily defined as individual.

Since the frames of HDV have the long GOP structure to define them, herein lies the problem for post-production; how can we work with the material if we must know what lies before, after and during? Luckily, the transport stream MPEG2 can be transmitted over IEEE1394 (aka FireWire). This means that the compressed HD material can be transferred into systems with the appropriate hardware and software (for example, a G5 with Final Cut Pro 5). While this seems like a simple solution for post-production, it means that the footage must be brought into the system as a rather heavily compressed format and that the computer must continue to work with the material as a MPEG2 transport stream, which is incredibly processor intensive for the computer.

The AJA KonaLH or AJA KonaLHe Solution

Enter the AJA KonaLH card for PCI-X Apple G5 computers, and the AJA KonaLHe for PCI Express Apple G5 computers. AJA Video Systems, Inc. has taken a unique approach to the HDV format and its potential professional applications. What if the post-production process demands that the HDV acquisition format be delivered as uncompressed HD to the Panasonic D5 or Sony HDCam formats for eventual HD broadcasts? Wouldn't certain post-production processes perform better in a 10 bit 4:2:2 color space than in an 8 bit 4:2:0 color space that is the domain of the compressed HDV format? And what about alleviating the processor intensive task of predicting frames and negotiating the long GOP structure inherent to the HDV format's MPEG2 stream? What if you could work with the material without the heavy compression, or at the very least, as an I-Frame format?



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How does the AJA KonaLH and LHe card answer these questions? First, KonaLH/LHe cards offer the most flexible connectivity among capture cards for Final Cut Pro. The KonaLH/LHe card can bring in material from the following example sources:

- Panasonic D5
- Panasonic DVCProHD
- Panasonic DVCPro50
- Sony HDCam
- Sony Digital Betacam
- JVC Digital S or D9
- Sony Betacam SP
- Panasonic or JVC S-VHS
- and other formats...

Including non-timebase corrected sources such as 3/4" Umatic, VHS and DVD players.

And finally HDV from JVC, Sony and Canon

How does the AJA KonaLH/LHe card connect to HDV and digitize material to uncompressed HD files for editing—or at the very least, to a lightly compressed I-Frame HD format? The answer to this is provided in a feature common to many HDV devices: analog HD output via component video. The component connectors on JVC cameras and decks, along with Sony cameras and decks, allows for the output of the long GOP MPEG2 data as a standard HD video format such as 720P, as with the JVC products—or 1080i as with the Sony products.

Since the KonaLH/LHe cards have the ability to digitize analog HD signals (a unique feature among capture cards on the market), the analog component output of the HDV devices can simply be connected to the KonaLH/LHe inputs. Note that HD signal cannot be transported over composite or S-Video (Y/C) cables, so the HDV device must have an analog component HD output. The KonaLH/LHe also has the ability to ingest analog audio, so the analog audio outputs of the HDV devices can be sent to the Kona card as well. (Also note that these analog audio outputs on the HDV devices are usually unbalanced RCA connections where the Kona card uses balanced XLR style connection so some sort of audio level correction device, such as a mixer or a stand alone active interface amplifier, should be used for accurately attenuated audio.)

Finally, you will want to control your device. Where all of the video, audio and timecode information moved over the FireWire cable, now you are dividing those tasks. Device control is the most difficult to configure for HDV devices because so few HDV devices have implemented any form of device control other than IEEE1394. The one notable exception is the JVC BR-HD50 HDV deck which has a remote serial port for RS422 protocol and device control. Other than this device you must follow several steps in order to gain control of the deck or camera from within Final Cut Pro via IEEE1394.

Working with the JVC HDV Format

With the introduction of the JVC GY-HD100U camcorder, JVC has brought a new level of user control to the growing HDV format. The camera has garnered interest due to its impressive feature set, removable lens and perhaps, most significantly, the first implementation of 720P 24p HDV. This implementation represented a new interpretation of the long GOP MPEG2 structure, with 6 frame long GOP. This structure, as opposed to 15 frame long GOP employed by Sony, is part of what allows the JVC camera to produce a true 24p frame rate. As of this writing, there is currently no FireWire 24p support available for native ingest of material; Final Cut Pro does currently support the other JVC HDV protocol of 720P 30 frame rate.

It is important, at this point, to explain that the JVC 24p methodology is not unlike the 24p strategy employed by Panasonic with its DVCProHD structure where the cameras (excepting the recently introduced AG-HVX200 model) always record 60 frames per second (59.94) and flag 24 (23.98) frames within the 60fps to be extracted, with extraneous frames removed on ingest to create media of a true 24p framerate (23.98).

Another reason to mention the Panasonic format, is that although they have no HDV implementation, they share the same SMPTE specification for their hardware outputs: 720P 59.94 with a 1280x720 raster sized image. Where the Panasonic devices can pass this signal via HD-SDI or component analog HD, the HDV output of the JVC devices relies solely on analog component HD.

The KonaLH/LHe can read this 720P 59.94 SMPTE specification freed from the native compression. This doesn't mean that you are improving what's been recorded on the tape; that compression has already occurred, but you can avoid working in a compressed, less accurate color environment by bringing the material into the system as an uncompressed HD 10 bit 4:2:2 signal as opposed to the compressed HD 8 bit 4:2:0 signal that would be native to a IEEE1394 transfer. A good way to look at this is as follows: in the DV acquisition world for SD broadcast we rarely want to work with DV tape as a 5:1 compressed format in 8 bit 4:1:1 color space in our editing system, but instead want to work with it for color correction, keying and compositing via an uncompressed SD signal in a 10 bit 4:2:2 color space. This is why so many facilities digitize the compressed DV signal to uncompressed file formats via SDI.

Furthermore, since you cannot natively ingest 24p, the only way to maintain correct frame cadence of the 24p is to ingest it as 59.94 (remember, 23.98 footage can always play out correctly as 59.94). This is the approach that the AJA KonaLH/LHe coupled with Final Cut Pro takes. This results in the best possible image quality from the recording and the smoothest motion playback.

JVC offers a deck that works great for just such a workflow because it offers analog component HD output, analog audio output and remote serial control via RS422A protocol. This makes hooking it up and digitizing to uncompressed 720P HD as easy as hooking up any broadcast deck to the AJA Kona card.

An outline for connecting the JVC BR-HD50 HDV deck follows:

1. Via the component analog BNC connectors on the JVC deck, connect to the AJA KonaLH/LHe analog component BNC connectors labeled for input.
2. Via the analog RCA audio connectors on the deck labeled for output, connect to a device that can correct potential attenuation issues, then to the analog KonaLH/LHe XLRs labeled for input.
3. Via the 9 pin remote jack on the deck, connect to the KonaLH/LHe. If you are using a standard male-to-male DB9 serial cable for RS422, then you will need a female-to-female gender changer to connect to the KonaLH/LHe's male RS422 connector. If you are using the optional KL-LH Box then you can connect directly to the Kona via a 9 pin male-to-male cable.
4. Before proceeding, the latest AJA KonaLH/LHe driver should be installed.
5. From the Kona Control Panel application, observe that the analog video input reads as 720P 59.94.
6. On the Input tab of the Kona Control Panel application, ensure that the input is set to analog as opposed to SDI and that the audio is also set to analog as the input option.
7. Launch Final Cut Pro. If you've just installed the Kona driver, then you will automatically be asked what Easy Setup you would like to choose. If this prompt appears, choose AJA KonaLH - 720P 59.94 10 bit (or 720P 59.94 8 bit). If this prompt does not appear, simply go to the Final Cut Pro pulldown menu and select it from the Easy Setup menu.
8. Ensure that you set the sequence to the appropriate AJA Kona 720P 59.94 setting, as it may default to some other setting and then clips would appear to need rendering in the timeline.
9. Ensure that you have drives adequate to sustain data rates for uncompressed 10 bit and 8 bit 720P 59.94 HD footage; storage performance should be higher than 150+MB/sec in order to digitize and playback the footage.

Also make certain that if you have such drives, that they are the selected as *Scratch Disk*; you can always check this via *Final Cut Pro*>*System Settings*>*Scratch Disks*.

Note: at the time of this writing users may not see clips in their browser when capturing 720P as clips but rather as subclips and if played back only black is apparent. Simply re-import clips with this issue from the directory level back into the Final Cut Pro browser to resolve this Final Cut Pro bug.

What if you simply want to work in an I-Frame, 4:2:2 8 bit editorial environment with high image quality but low drive requirements? Then digitizing to the DVCPProHD codec offers you the best choice. The codec is very efficient, but produces high quality. The files go from 150MB/sec to just over 14MB/sec.—a savings of roughly ten times the drive space of uncompressed 10 bit HD! The AJA KonaLH/LHe card offers the option to compress to this codec in realtime while digitizing. You can do this by simply choosing the KonaLH - 720P 59.94 DVCPProHD Easy Setup.

One nice function of this is that a show might choose to shoot some footage on the JVC GY-HD100U and some footage on the Panasonic AJ-HDC27H Varicam and easily integrate the two. If you were to digitize to the 10 bit uncompressed format, you could then use the HD-SDI output of the AJA KonaLH/LHe card to master to Panasonic's D5 or Sony's HDCamSR series VTRs. Or if you digitized to the DVCProHD codec, you could choose to master, via FireWire back to the DVCProHD format by using the Panasonic AJ-HD1200A VTR with the FireWire option installed.

If HD is not your goal for a final delivery format, the KonaLH/LHe can also perform broadcast quality HD to SD downconversion. Again, the flexibility of the KonaLH/LHe inputs and outputs allows for flexible ingest, editorial and mastering scenarios when used in conjunction with the JVC HDV format.

Working with the Sony HDV Format

Sony, following its success with the MiniDV market, introduced its HDV camcorders to the world after JVC introduced the format. Unlike JVC's 720P implementation, Sony chose to use a format that would output a raster image that would match that of their existing HDCam format, 1920x1080. Like the HDCam products, the Sony HDV camcorders work with images as 1440x1080, but these are scaled to full 1920x1080 for playback on analog devices. Just like the JVC HDV format, the analog component output of the Sony devices meets a SMPTE specification of 1080i 29.97 that the analog inputs of the KonaLH/LHe can understand. For technical purposes, it should be duly noted that Sony's 1080i 29.97 long GOP structure is 15. This structure is already one that Final Cut Pro 5 can read natively, so you could choose to ingest the material via FireWire. Again, if you want to avoid working in the compressed environment that the information was recorded in and you want to work in an I-Frame format, then this would not be the right choice. A side note is that if you choose this method, you can still use the KonaLH/LHe card (or the Kona2) to play the material out to HD or SD via the playback settings in Final Cut Pro—set to AJA Kona 1080i29.97 8 bit (1920x1080).

An outline for connecting the Sony HVR-M10U HDV deck follows:

1. Via the component analog RCA connectors on the Sony deck, connect to the AJA KonaLH/LHe analog component BNC connectors labeled for input. (I would recommend using a BNC to BNC component cable with female BNC to RCA male adapters at one end to connect to the deck.)
2. Via the analog RCA audio connectors on the deck labeled for output, connect to a device to correct potential attenuation issues, then to the analog KonaLH/LHe XLRs labeled for input.
3. Since there is no 9 pin remote jack on the deck, connect the iLink 4 pin IEEE1394 to the Apple G5 with the appropriate FireWire cable. You will need to modify the settings of the deck and of the Easy Setup provided by AJA to make this deck work, connected to the KonaLH/LHe. The deck offers an iLink downconvert option that will turn the HDV signal into a DV signal over the iLink. Set this to downconvert, being aware that this will not effect the component HD analog output and that you will need to power cycle the deck without a tape in it for this to take effect.
4. Before proceeding, the latest AJA KonaLH/LHe driver should be installed.
5. You will also need to install the DisablePolling text file into the Library>Application Support>Final Cut Pro System Support>Plugins folder. This file transforms the Final Cut Pro device control settings back to the state in which they were in Final Cut Pro version 4.5 aka Final Cut Pro HD. It is also wise to throw away the preferences for Final Cut Pro at this point as well. Users>(User with the home icon)>Library>Preferences and then within this list the following:

com.apple.FinalCutPro.plist
(within the Final Cut Pro User Data folder the following)
Final Cut Pro 5.0 Prefs
Final Cut Pro Obj Cache
Final Cut Pro Prof Cache
6. From the Kona Control Panel application, observe that the analog video input reads as 1080i 29.97.

7. On the Input tab of the Kona Control Panel application, be sure that the input is set to analog as opposed to SDI and that the audio is also set to analog as the input option.
8. Launch Final Cut Pro. If you've just installed the Kona driver, then you will automatically be asked what Easy Setup you would like to choose. If this prompt appears, choose AJA KonaLH - 1080i 29.97 10 bit (or 1080i 29.97 8 bit). If this prompt does not appear, simply go to the Final Cut Pro pulldown menu and select it from the Easy Setup menu.
9. Now you will need to modify the Audio/Video Settings>Device Control Presets so that instead of using the KonaLH card, you are using the Firewire NTSC setting. Sometimes this change does not take due to communication with the deck and any combination of rebooting, power cycling the deck may resolve the issue. Once you've established that you have control of the device via the Log and Capture window, saying VTR OK, then you will have completed this task. As an added measure I've found that it sometimes works best when the HDV deck is set to *Video In* for its input as opposed to HDV or DV.
10. Make certain that you set the sequence to the AJA Kona 1080i 29.97 setting that is appropriate, as it may be defaulted to some other setting and then clips would appear to need rendering in the timeline.
11. Make certain that you have drives adequate to sustain data rates for uncompressed 10 bit and 8 bit 1080i 29.97 HD footage; storage performance should be higher than 170+MB/sec in order to digitize and playback the footage. Also ensure that if you have such drives, that they are the selected Scratch Disk; you can always check this via *Final Cut Pro>System Settings>Scratch Disks*.

Finally, just like the JVC workflow, you could alternately digitize to the DVCProHD codec for storage space savings and to use lower performance drives while maintaining the ability to work with the material as an I-Frame format. In this case, you would digitize using the AJA Kona LH- 1080i 29.97 DVCProHD Easy Setup and again modifying the Device Control Presets to use Firewire NTSC. You could output this material to Panasonic D5, HDCamSR, HDCam or Panasonic DVCProHD tape formats as 1080i 29.97. As mentioned previously, the AJA KonaLH/LHe card—coupled with Final Cut Pro, provides for an uncompressed or compressed HD I-Frame editorial environment that is easier for deliverables, and less processor intensive for the machines where it will be edited.

Note: Canon footage shot on the XL H1 can be played back on the Sony HDV deck so I have not included it in a separate category. Uniquely Canon does offer an HD-SDI output option so that output could be fed directly to the KonaLH/LHe HD-SDI input instead of via deck analog component HD output.

