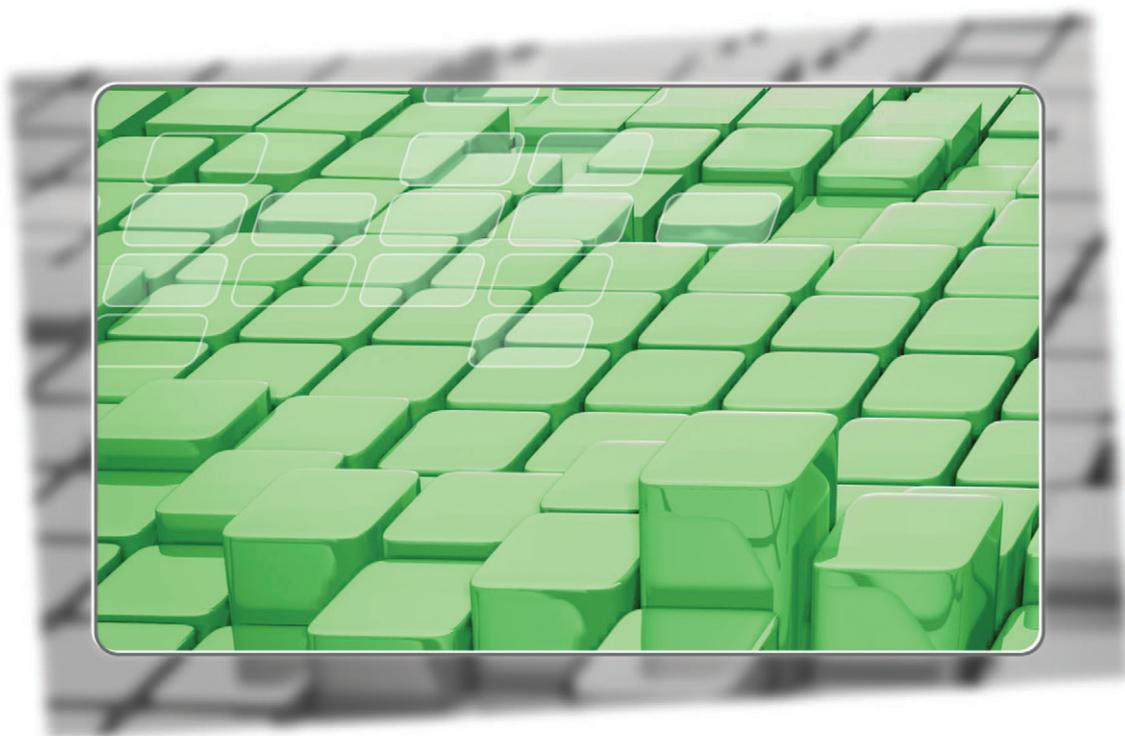


HQ Software Codec Technical Advantages



HQ Software Codec

1 Overview of the HD Market and the Positioning of Canopus

There has been a rapid increase in the use of high definition (HD) content, driven by factors such as the trend towards digital broadcasting and the establishment of business models for content reuse. This has led to a growth in the demand for HD non-linear editing systems with excellent cost-performance.

Canopus has produced a solution that provides a smooth transition from standard definition (SD) to HD and is the first in the world to deliver realtime multi-format support for DV, HDV, SD, and HD. The solution also supports the editing of P2 MXF and XDCAM MXF files on the same timeline. The P2 MXF and XDCAM MXF formats are seen as next-generation media.

The Canopus HD editing system also incorporates the "Canopus HQ Software Codec" which were developed independently by Canopus.

The highly advanced compression technology implemented in these codec allows the size of data files to be reduced which not only enhances the ease with which realtime editing can be performed but also contributes to lower system cost and more flexible scalability such as in network configurations. As a result, solutions can be provided that are optimized for the customer's preferred workflow.

2 Advantages of Compression

Clearly, you can use "uncompressed data" if you want to ensure absolutely no loss in image quality. However, using "uncompressed data" results in huge data volumes and, even using the latest high-performance workstations and high-speed/large-capacity hard disks, this approach is not really practical, with problems including

unsuitability for realtime editing and the need for rendering. Considering the overall investment by the customer in their editing system, the use of uncompressed data would require an extremely large amount of storage capacity. This in turn would require the installation of multiple high-speed/high-capacity hard disks and the configuration of RAID systems or similar, leading to a significant increase in the cost of the investment. The size of uncompressed data also affects the system's "speed" and makes realtime editing difficult to achieve in practice. This speed problem caused by the large data amount would also be an obstacle to network-based operation, and a networked flow that uses uncompressed data would be impractical for a number of reasons including both cost and speed.

3 Advantages of Software Codec

Compression can be performed either in hardware or in software. The "Canopus HQ Software Codec" is Canopus proprietary software codec and features the following advantages.

(1) Flexibly scalable systems can be configured

As the operation does not depend on the hardware, functions can be extended or added easily. Network-based video editing systems have to support even more formats than in the past, including new formats. Software codec can be quickly upgraded to support new formats and this provides opportunities for content reuse.

(2) Expandability in conjunction with improvements in the platform

CPU processing performance is likely to keep on improving rapidly in the future. In this environment, using a software codec means that enhancements, such as increasing the number of streams that can be played simultaneously or performing realtime processing such as compositing, transitions or filtering, can be added as improvements in CPU processing performance allow.



EDIUS provides a stress-free editing environment for formats that utilize both HD and SD

4 Variable Bitrate Technology Delivers High Image Quality

The "Canopus HQ Software Codec" adjusts the compression rate dynamically depending on the image and delivers high image quality comparable to or better than HDCAM or DVCPRO HD.

Reproducibility of detail can be lost in particularly complex images for media such as tape where the bitrate is fixed by the format, but this problem does not occur if a variable bitrate is used. However, to prevent the data volume from becoming too large, it is now possible to set a maximum bitrate limit.

Variable bitrate technology that allows the data size to be reduced while maintaining image quality have significant benefits for non-linear editing systems.

Role of the Pre-Filter

Both HDCAM and DVCPRO HD use a pre-filter to compress 1920 horizontal pixels into 1440 (HDCAM) or 1280 (DVCPRO-HD). Although other non-linear editing systems also typically use a similar pre-filter, there is a significant difference in image quality depending upon whether this is implemented in hardware or software.

Because it is not possible with current CPU performance to use a software pre-filter with ideal characteristics in realtime, it is necessary to give priority to speed at the expense of the characteristics and this causes a deterioration in image quality. The EDIUS HD is a hardware implementation of a pre-filter that is based on Canopus's long experience in codec technology and hardware technology and provides an ideal level of characteristics at the HD deck level.

5 Supports Full 1920 x 1080 HD Resolution

The Canopus HQ Software Codec also supports the maximum HD resolution of 1920 x 1080. By compressing the full HD resolution without using a pre-filter to down-sample the signal, the codec is able to preserve the frequency characteristics of the original almost perfectly. Further, because compression is performed efficiently using a variable bitrate, the data volume can be reduced to approximately one-fifth of the original. The Canopus HQ Software Codec is also ideal HDCAM-SR VTR, HD-D5 VTR, and similar workflows in applications that require high quality such as CM production and studio recording.

6 Alpha Channel Support

The Canopus HQ Software Codec can perform compression with high image quality while retaining the alpha channel. Until now, working with files that incorporate an alpha channel has typically meant using formats such as uncompressed sequential still image data or uncompressed AVI data, resulting in files that are large and cumbersome. Using the Canopus HQ Software Codec not only allows the size of video data with an associated alpha channel to be significantly reduced, it also provides much better playback performance during editing. Because the Canopus HQ Software Codec also supports VFW (Video for Windows), it can be selected as the compression codec in many 3DCG, animation and compositing software packages, and this provides the opportunity to make considerable improvements in workflows that are currently forced to use uncompressed data.

* Supported in EDIUS (Ver. 4.0 or later)

7 Image Quality and Capacity of HD Decks and Canopus HQ Software Codec

The table below lists the pre-filter, bitrate, and other parameters that influence image quality.

Comparison of pixel compression for each type of codec

	HDV720p	HDV1080i	DVCPRO HD	HDCAM	Canopus HQ Codec 1440	HD-D5	HDCAM-SR	Canopus HQ Codec 1920	Uncompressed HD
Horizontal resolution (Pixel)	1280	1440	1280	1440	1440	1920	1920	1920	1920
Vertical resolution (Pixel)	720	1080	1080	1080	1080	1080	1080	1080	1080
Number of brightness pixels when compressed	1280	1440	1280	1440	1440	1920	1920	1920	1920
Number of color difference pixels when compressed	640	540	640	480	720	960	960	960	960
Bitrate	19Mbps	25Mbps	100 Mbps (approx.)	140 Mbps (approx.)	Variable	235Mbps	440Mbps	Variable	995Mbps*

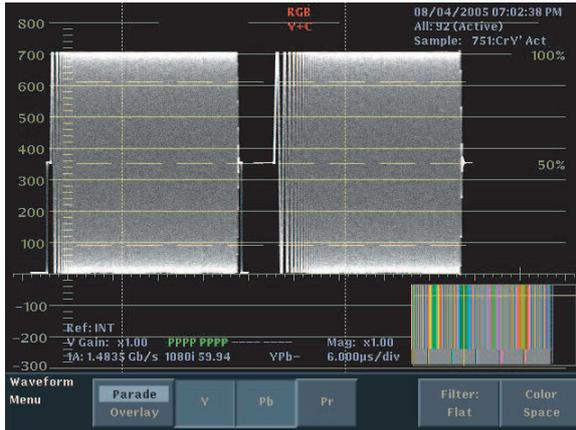
* The original HD data for YCbCr 4:2:2, 8 bit, and 30 fps

Comparison of Frequency Characteristics

A SWEEP image is an image in which the amplitude stays constant but the frequency gradually increases from the left to the right of the screen. This can be used to confirm and evaluate how well the image quality is maintained in the compression and decompression process. For example, the amplitude at the right of the screen can be seen to decrease if the high-frequency components are cut. The ↗

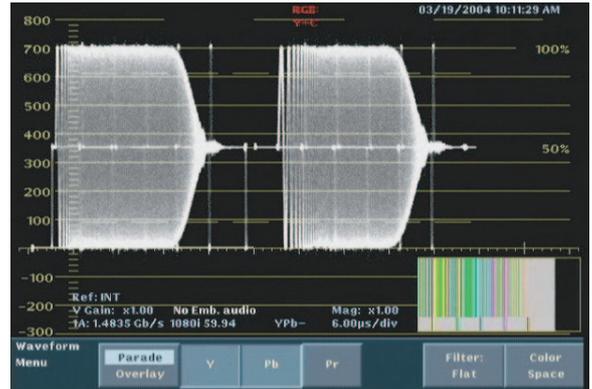
Verifying the High Image Quality of the "Canopus HQ Software Codec 1440 x 1080"

[Figure 1 Original Uncompressed Image]



* Left: Y-1290 pixels Right: PbPr-960 pixels

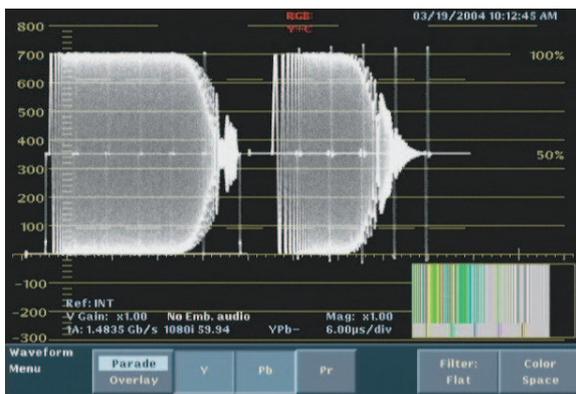
[Figure 2 DVCPRO HD Image]



Compression is performed after first reducing from the horizontal 1920 brightness data to 1280 pixels maintaining 4:2:2 sampling. Overall, the frequency characteristics have fallen to 2/3 of the original.

* Left: Y-1280 pixels Right: PbPr-640 pixels

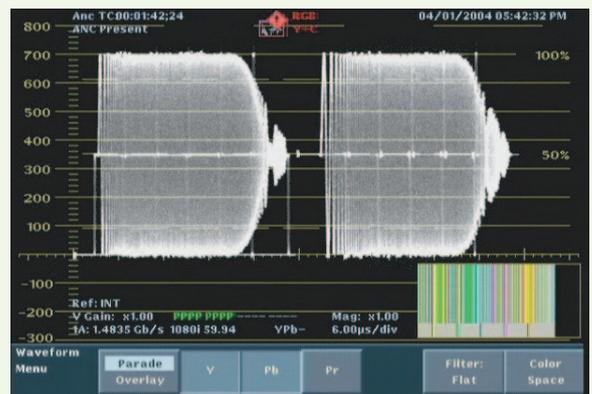
[Figure 3 HDCAM Image]



This reduces the brightness data by 3/4 to 1440 pixels. The color difference data is reduced by 1/2 to 480 pixels. Compared to DVCPRO HD, the frequency characteristics for the brightness data are better but the color data characteristics are worse.

* Left: Y-1440 pixels Right: PbPr-480 pixels

[Figure 4 Canopus HQ Software Codec 1440 x 1080 Image]



The entire image is reduced by 3/4 to 1440 pixels while maintaining 4:2:2 sampling. The brightness data is equivalent to that of HDCAM and the frequency characteristics of the color data are better than DVCPRO HD and HDCAM.

* Left: Y-1440 pixels Right: PbPr-720 pixels (equivalent to 137 Mbps)

These figures show that the image compressed using the "Canopus HQ Software Codec 1440 x 1080" in Figure 4 has the waveform closest to the original uncompressed image in Figure 1. In other words, the compression technology from the "Canopus HQ Software Codec 1440 x 1080" allows editing to be performed with no degradation of DVCPRO HD and HDCAM images.

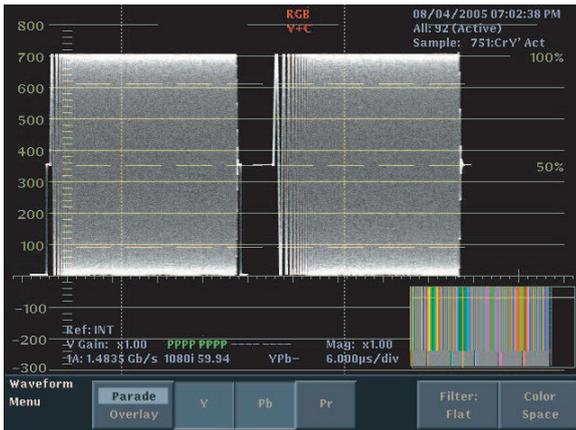
Using a SWEEP Image

image used here goes from 1 MHz on the left to a Y component of 30 MHz and PbPr component of 15 MHz on the right.

* The reason why two waveforms are shown in the waveform monitor image is because, for a particular line, the left side is the Y component waveform and the right side is the Pb component waveform. However, because the Pb component and Pr component have exactly the same characteristics, the right side is labeled PbPr.

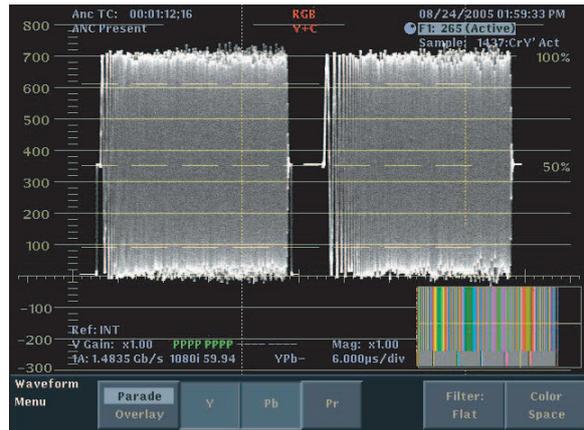
Verifying the High Image Quality of the "Canopus HQ Software Codec 1920 x 1080"

[Figure 5 Original Uncompressed Image]



* Left: Y-1920 pixels Right: PbPr-960 pixels

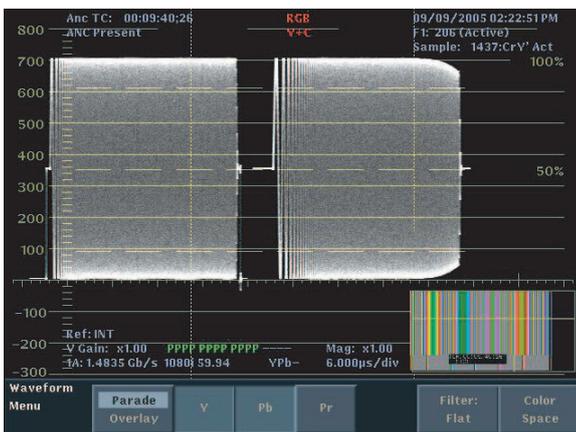
[Figure 6 Image]



Compared to the waveform in Figure 5, no significant differences can be seen. That is, this shows that the frequency bandwidth is preserved adequately and the high image quality is maintained.

* Left: Y-1920 pixels Right: PbPr-960 pixels

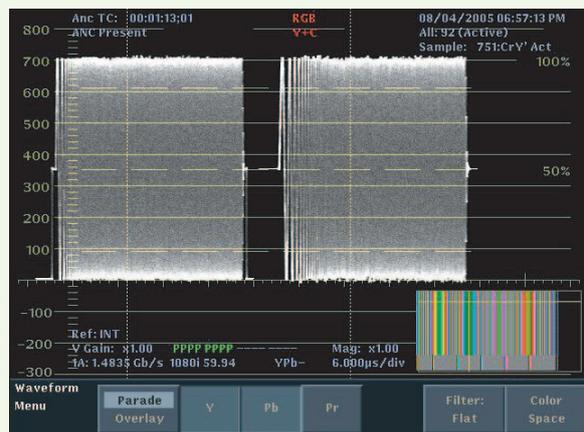
[Figure 7 HDCAM-SR Image]



Compared to the waveform in Figure 5, no significant differences can be seen. That is, this shows that the frequency bandwidth is preserved adequately and the high image quality is maintained.

* Left: Y-1920 pixels Right: PbPr-960 pixels

[Figure 8 Canopus HQ Software Codec 1920 x 1080 Image]



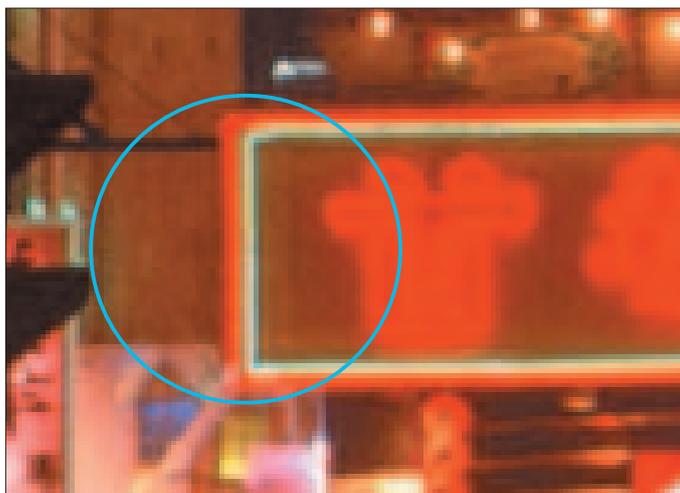
Compared to the waveform in Figure 5, adequate frequency bandwidth is preserved, similar to Figures 6 and 7, and this indicates that high image quality is maintained.

* Left: Y-1920 pixels Right: PbPr-960 pixels

HD-D5 and HDCAM-SR operate using 4:2:2 and, compared to the original uncompressed image in Figure 5, the results show that an adequate frequency bandwidth is preserved, which indicates that the image quality is maintained (Figures 6 and 7). Similarly, the "Canopus HQ Software Codec 1920 x 1080" in Figure 8 also operates using 4:2:2 and therefore, when compared with and HDCAM-SR, it can be seen that this codec can perform compression with no associated image degradation.

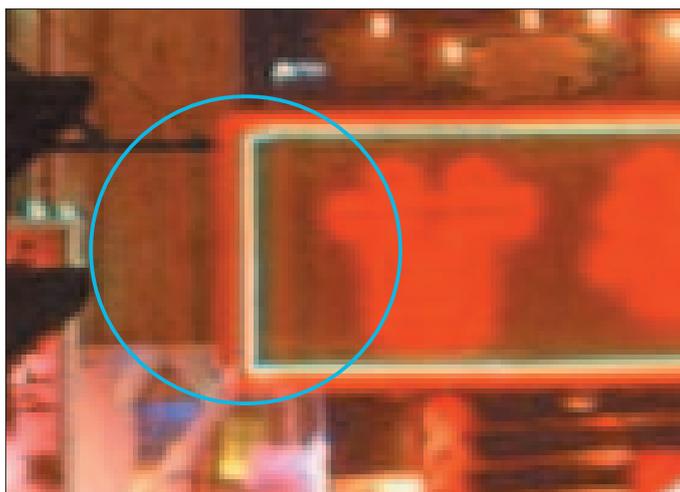
Actual Performance of "Canopus HQ Software

Actual images using HDCAM and "Canopus HQ Software Codec 1440 x 1080" were compared.

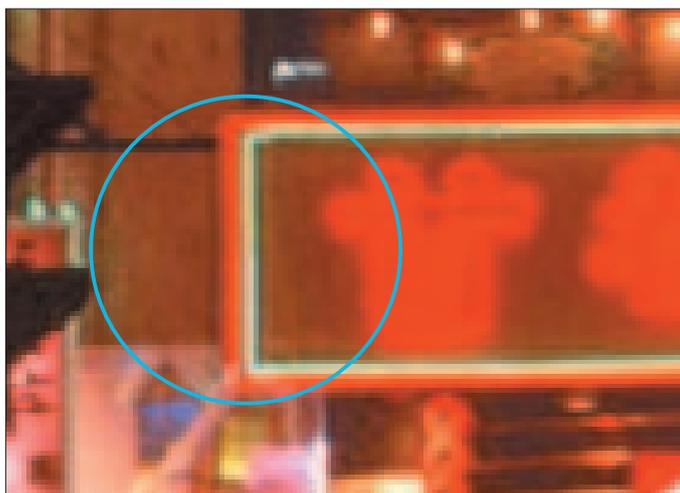


Original

It can be seen that the images sampled at 4:2:2 by the "Canopus HQ Software Codec 1440 x 1080" have better color resolution than the HDCAM images that use 3:1:1. In HDCAM images, a red line smear is visible on the left edge of the vertical white line and a black line artifact has appeared on the right edge.

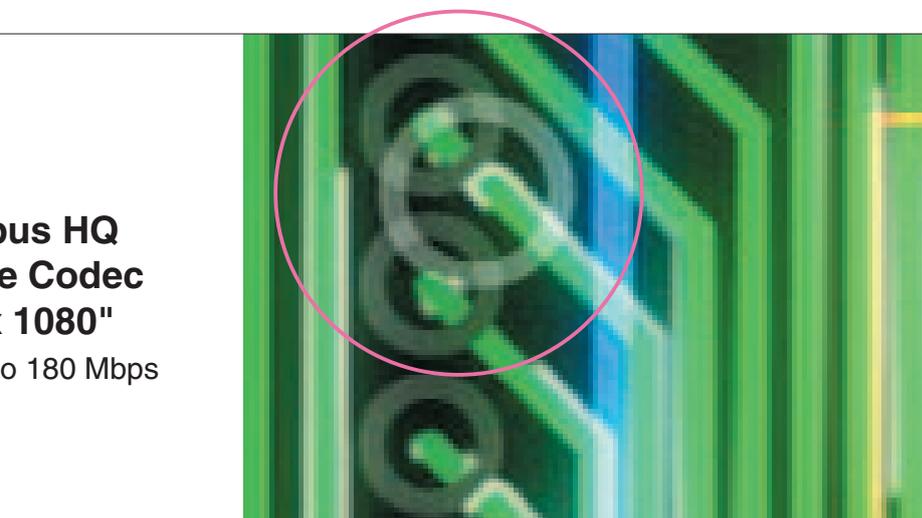
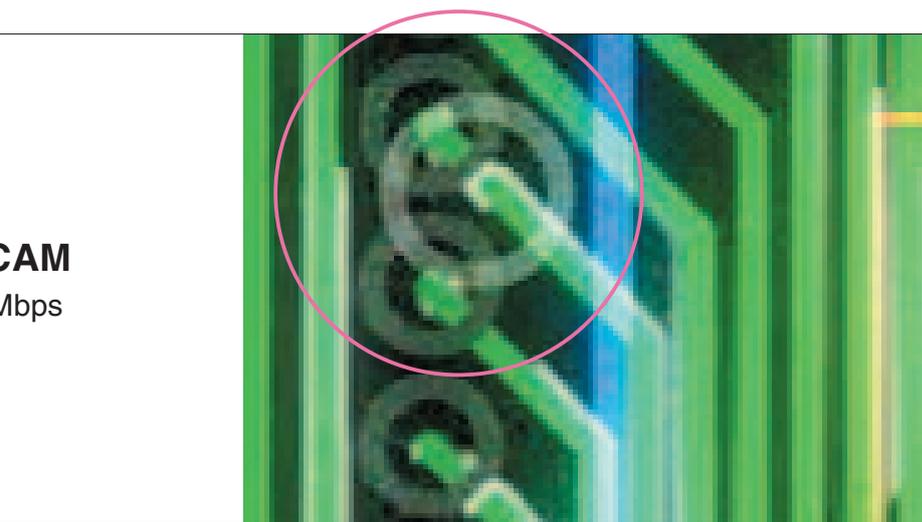
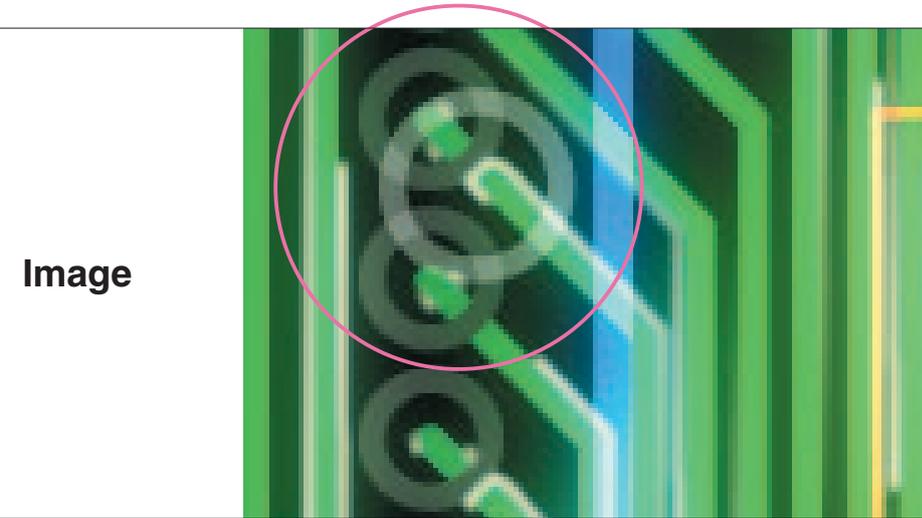


HDCAM
1440 x 1080



"Canopus HQ Software Codec 1440 x 1080"
Equivalent to

Codec 1440 x 1080"



It can be seen that the images sampled at 4:2:2 by the "Canopus HQ Software Codec 1440 x 1080" have better color resolution than the HDCAM images that use 3:1:1.

Actual Performance of "Canopus HQ Software Codec 1920 x 1080"

Actual images using HD-D5, HDCAM-SR, and "Canopus HQ Software Codec 1920 x 1080" were compared.



Original Uncompressed Image (995 Mbps)



HDCAM-SR Image (440 Mbps)



HD-D5 Image
(Panasonic HD-D5 235 Mbps)

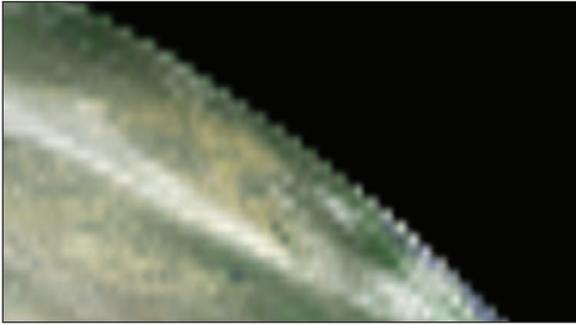


"Canopus HQ Software Codec 1920 x 1080"
Image (203 Mbps [measured speed])

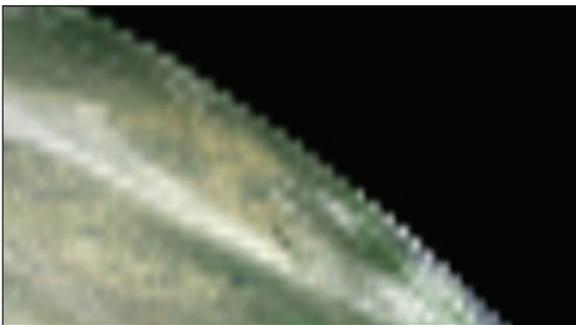
When compared to the original image, the results clearly show that the "Canopus HQ Software Codec 1920 x 1080" has absolutely no loss of quality. Compared to the image, there is clearly less roughness and the result is much closer to the original image.

Advantages of Alpha Channel Support

Uncompressed AVI



Canopus HQ Software Cordec (1920 x 1080 + alpha channel)



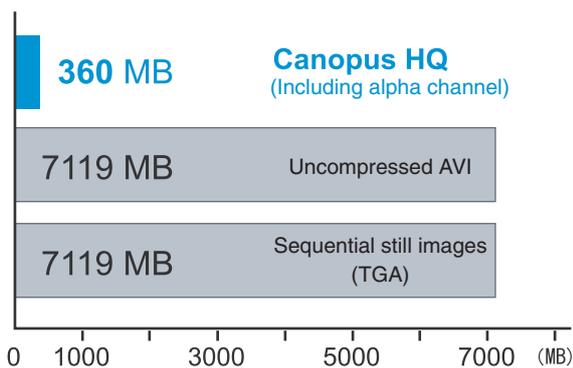
Compared to an uncompressed AVI file, the sample data is converted into a file with a size* only one-twentieth that of the uncompressed file, without any loss in quality. Because the file size is smaller, the time required for operations such as copying data or writing data to the hard disk after rendering will obviously be shorter, and this allows you to do things that were impractical in the past, like delivering files on DVD-R media or making backups. It also reduces the volume of traffic when operating over a network, making possible workflows that you avoided using in the past due to the large size of "uncompressed data" files. Offering improved productivity and lower production costs while maintaining high quality, the "Canopus HQ Software Codec" is an exceptional piece of technology that is essential in HD editing systems that handle large data volumes.

* Because a variable bitrate (VBR) is used, the file size varies depending on the video content.

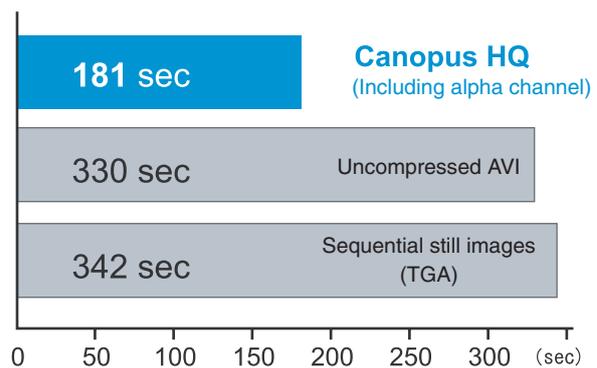
Sample data



Comparison of File Sizes



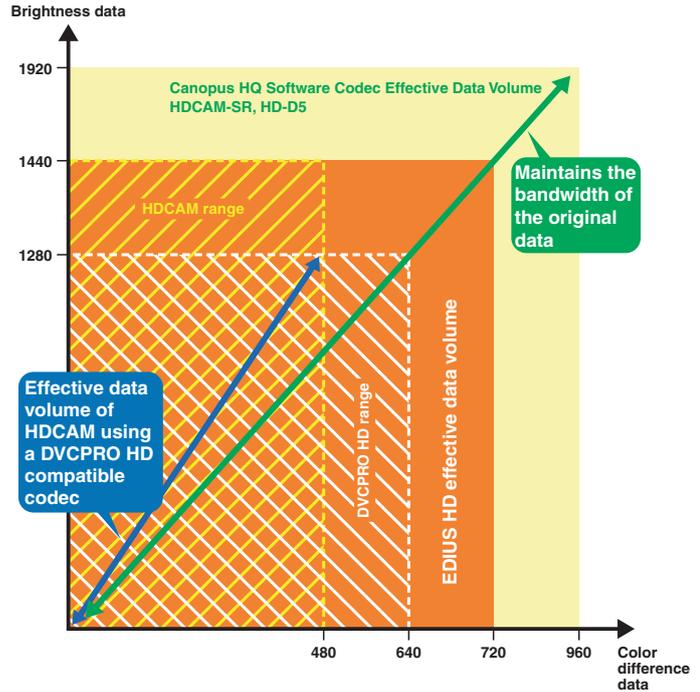
Comparison of Output Times



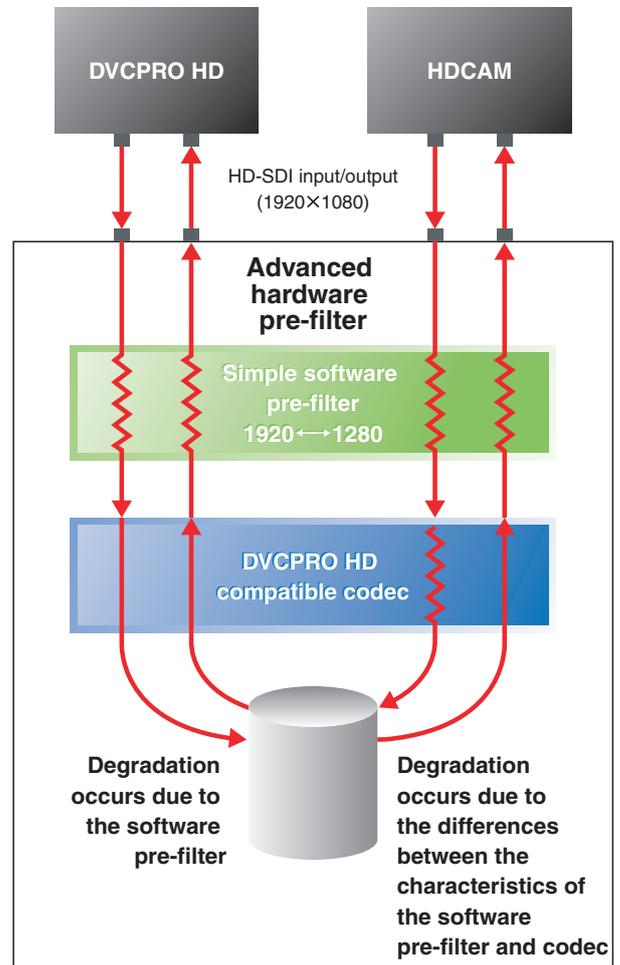
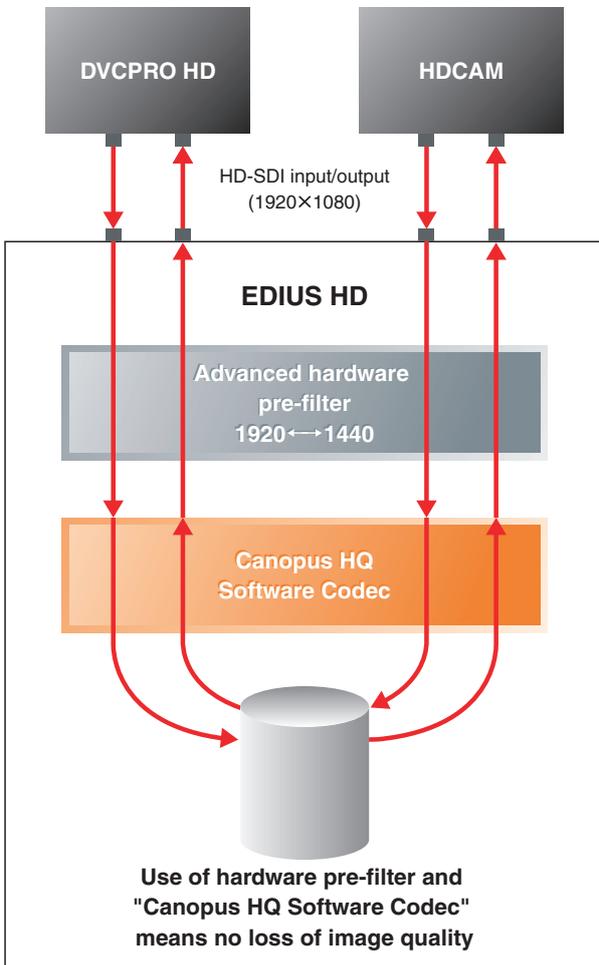
Test system: ThinkPad T60p/CPU Intel Centrino Duo T2600/2.0GB RAM 2GB Adobe® After Effects® 6.5

8 Comparison of Non-Linear Editing Systems that Use the Canopus HQ Software Codec and Other Software Codec

When images are captured on HDCAM via HD-SDI using a non-linear editing system produced by another vendor that uses a DVCPRO HD compatible codec, for example, the effective data volume for HDCAM compression falls from 1440 to the DVCPRO HD equivalent level (1280) for brightness. When capturing DVCPRO HD images on a non-linear system from another vendor that uses a HDCAM compatible codec, on the other hand, the original 640 color difference is reduced to the HDCAM equivalent level (480) resulting in a loss of information and degradation of the image quality in the signal conversion between the two formats. Canopus has developed a hardware pre-filter with performance equivalent to VTR and incorporated this into its systems. As other vendors' non-linear systems use software pre-filters, they are unable to maintain the same image quality as the original in this stage, not only for an HDCAM source, but also for a DVCPRO HD source. The "Canopus HQ Software Codec", however, has superior characteristics to both DVCPRO HD and HDCAM, and



therefore the original image quality can be preserved whichever of these is used as the source.



Column

[Application to HDV Format]

The HDV standard uses MPEG2 inter-frame compression (long GOP) and while this has the advantage of reducing the data volume, it means that multiple frames need to be decompressed when editing which makes the format difficult to handle for realtime non-linear editing systems. This problem has been solved by the "HQ Capture" function which transcodes HDV format video in realtime using the "Canopus HQ Software Codec" and saves on a HDD. The "Canopus HQ Software Codec" achieves a level of quality greater than broadcast HD formats such as HDCAM, and can be used to handle both HD video from an HD-SDI source and HDV video from an IEEE1394 source in the same workflow.

[Canopus HD Software Codec]

The "Canopus HD Software Codec" is another realtime HD codec. The codec complies with the SMPTE-370M (intra-frame type, 100Mbps transmission rate, 1280 x 1080i resolution, 4:2:2 sampling) DVCPRO HD standard, has a level of image quality equivalent to DVC PROHD, and is certified as a "compatible codec" by Matsushita AVC. Because it uses a fixed bitrate, the codec is suitable for applications where you want to prevent variations in data volume from affecting network traffic.



The Canopus Workflow

Canopus makes innovative products that streamline all aspects of the video post-production process: Create, Purpose and Deliver. Canopus products may be grouped within these workflow categories.



CREATE > PURPOSE > DELIVER

About Canopus

A leader in advanced codec technology, Canopus has gained international acclaim as professionals around the world recognize the exceptional qualities of the content they create, purpose and deliver with Canopus video editing, transcoding and network-based video distribution systems. Engineering-driven products bearing the Canopus brand name combine innovative hardware and software designs that set new standards in performance, functionality and reliability.

www.canopus.com

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