



Transcoding 101

by Dominic Milano

Video is being produced and consumed in more ways and on more devices than ever. Motion pictures are shot on video and distributed on standard- and high-definition DVDs and displayed theatrically using the latest digital video projectors. Promotional videos are screened in taxicabs, on point-of-purchase displays and on gigantic monitors in airports, shopping malls and sports arenas. Video has become part and parcel of internal and external corporate communication. Personalized weather reports, sports news and movie trailers play on cell phones and other mobile devices. Home videos of cats flushing toilets attract millions of online viewers on video sharing sites... Video content permeates the media landscape in endless ways.

As video content becomes more and more pervasive, content creators and distributors face a dizzying array of options when deciding which video formats best suit their internal production, post-production and archival needs. And the list of competing, incompatible formats for broadcast playout and delivery online, on DVD and on mobile devices is just as daunting. Because there is no single format that can be all things to all people, transcoding technology is fast becoming the linchpin in enterprise and broadcast content delivery pipelines.

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Transcoding is the process of translating or converting one format to another. Transcoding facilitates moving media across production, post-production, archival and delivery ecosystems.

This document provides a high level overview of transcoding terminology, technology and workflow. It is intended to help enterprise and media executives understand how to extend the reach of their existing media assets, increase their ROI and leverage the power of exciting new delivery platforms in a cost-effective, scalable manner.

For professional, enterprise and broadcast facilities that require seamless universal media transcoding, Rhozet™ Carbon Coder and Carbon Server provide a powerful, flexible, scalable solution. High-volume, complex workflows can be handled with surprising simplicity via robust automation features that can be customized via the Rhozet XML-based API. Carbon Coder and Carbon Server offer comprehensive format support for moving media across production, post-production, archival and delivery systems smoothly, efficiently and in the most cost-effective manner possible.

More Transcoding Terminology

3G2 — 3GP is a multimedia container format defined by 3GPP for use on 3G mobile phones. It is a simplified version of MPEG-4 Part 14 (MP4). 3GP files have the filename extension .3gp or .3g2.

3GPP — The term “3GPP specification” covers all GSM (including GPRS and EDGE) and W-CDMA specifications.

AAC — Advanced Audio Coding is a standardized, lossy compression and encoding scheme for digital audio. Designed to be the successor of the MP3 format, AAC generally achieves better sound quality than MP3 at many bit-rates.

AMC — Audio Modem Codec designed for use with relatively low-bitrate V.90 data modems with receive rates up to 56 kbps.

AMR-NB — Adaptive Multi-Rate Narrow Band compression is a vocoder employed in low-bitrate applications like mobile phones.

ASF — Advanced Systems Format (formerly Advanced Streaming Format, .asf), a Microsoft streaming format associated with Windows Media Player.

AVI — Audio Video Interleave is a multimedia container format introduced by Microsoft as part of Video for Windows.

Broadcast WAV — Also known as BMF (Broadcast WAV format), this format adds metadata to the popular WAV audio file format.

DivX — A container officially known as the DivX Media Format. The codec of choice is MPEG-4 Part 2. DivX is a variation on the AVI container format.

DTS — Digital Theater Systems is a multi-channel digital surround sound format used for commercial/theatrical and consumer in-movie sound, both on film and on DVD.

The Vocabulary of Transcoding

Understanding Codecs and Containers

Discussions of transcoding are inevitably laced with jargon such as **codec** and **container**.

The word “codec” is a combination of **CO**mpression and **DE**Compression — words that describe what codecs do. They compress media on input and decompress it on playback.

A “container” can also be called a “codec container,” a “media container” or a “wrapper.” As the names imply, a container is a technology that can house many different codecs. QuickTime, for example, is a codec container that can accommodate nearly any type of media including animation, music, speech, text, video and much more. For QuickTime and other containers, each media type might be supported by one or more codecs. Other examples of codec containers include AVI, WAV, MPEG-2, broadcast WAV, ASF, WMV, WMA, 3GPP and 3G2. Like QuickTime, these formats can host multiple codecs. PCM, GSM, ADPCM, CELP, SBC, TrueSpeech and MPEG Layer-3 (MP3) are the codecs available for WAV (short for waveform) audio files. If you are unfamiliar with these acronyms, see *More Transcoding Terminology* in the sidebar.

Understanding Formats and Platforms

Formats and **platforms** are two more terms essential to the discussion of transcoding.

“Platforms” are the devices on which a project will be produced, edited, archived and/or delivered/viewed.

A “format” comprises one or more containers and a set of codecs. Formats can be either platform-specific or platform-independent. Windows Media Video (WMV) is one such platform-specific format. WMV content is intended to be played back on Windows Media Player and compatible applications. MPEG-1 is an example of a platform-independent format. Flash is a cross-platform, platform-specific format. That is, Flash Player is compatible with a variety of operating systems, but Flash content is intended for playback on the Flash family of players, which includes Flash Player, Flash Lite for mobile playback and Adobe Media Player.

Some formats include multiple containers. MPEG-2, for example, has two container types — TS (transport stream) and PS (program stream). TS is for video, audio and data used in broadcast applications; PS is for more stable delivery environments such as DVDs. Both TS and PS utilize the H.262 video codec, but impose different sets of constraints on parameters such as image resolution, frame rate and data rate to accommodate their respective delivery platforms’ characteristics.

More Transcoding Terminology *continued*

DV — Intraframe codec and tape format that stores video at a fixed rate of 25 Mbps and audio at 1.5 Mbps. Variations include Panasonic DVCPRO50 and DVCPRO100 (aka DVCPROHD), which sample at 50 Mbps and 100 Mbps respectively. Color subsampling is 4:1:1 for DV25 NTSC and DVCPRO PAL. Color subsampling is 4:2:0 for PAL. DVCPRO50 and DVCPRO100 use 4:2:2 color subsampling.

Flash — A container format for multimedia technologies originally developed to stream vector and raster graphics and audio at low bitrates. Flash supports a number of video and audio codecs, including On2 VP6, Sorenson Spark, MP3, ADPCM, AAC, Speech and RAW audio.

GXF — General Exchange Format is a container format associated with SMPTE360.

H.263 — A low-bitrate codec originally designed for video conferencing.

H.264 — A scalable video codec designed to provide better quality at substantially lower bitrates than H.262, H.263 or the MPEG-4 Part 2 video codec. Also known as AVC and MPEG-4 Part 10.

HDV — An inexpensive high-definition video recording format that uses MPEG2 compression to fit HD content onto the same DV or MiniDV tapes originally developed for standard definition recording. HDV compresses data both within each frame (intraframe/spatial compression) and between frames (interframe/temporal compression). HDV 1080i uses a recording data rate of 25 mbps, while HDV 720p records at 19.7 mbps.

JPEG 2000 — Highly scalable wavelet-based image compression standard supported by the Digital Cinema Initiatives for storing, distributing and exhibiting motion pictures. It's also being considered as the archival format for the Library of Congress.

A number of formats, platforms and even codecs share names. Windows Media/Windows Media Player and QuickTime/QuickTime Player are two examples. The MPEG-4 format shares its name with a codec. The MPEG-4 format is actually a suite of standards called "parts." MPEG-4 Part 2 is the MPEG-4 video codec. MPEG-4 Part 10 is a different video codec — H.264, also known as MPEG-4 AVC (Advanced Video Coding).

Understanding Bitrate, Data Rate and Bandwidth

Three additional terms — **bitrate**, **data rate** and **bandwidth** — are essential to understanding compression and transcoding. These terms are interchangeable and refer to the number of bits conveyed or transferred per unit of time. For example, DV25 refers to the DV codec with a data rate of 25 megabits per second; DV50 is DV footage captured at 50 megabits per second.

Higher bitrates and more bandwidth generally equate with better quality. Choosing a format optimized for whatever bandwidth is available in your production, post-production, archival or delivery medium is essential to getting maximum quality.

The plethora of possible format and codec combinations makes describing them all absurdly complex. Simply put, formats and codecs are born of the need to take maximum advantage of prevailing data rate and bandwidth conditions. As access to greater bandwidth proliferates, new formats and codecs are developed to maximize image and audio quality. Discussing which codec is best suited for a particular situation, however, is beyond the scope of this white paper.

Why Format Conversion is Critical

The promise of "author-once-deliver-anywhere" efficiency starts with making the most of prevailing data rate and bandwidth conditions. Prevailing conditions in production, post-production, archival and delivery media, however, are wildly disparate. Best practice models inevitably start with the highest possible image and audio quality and modify it as necessary to accommodate the characteristics of various delivery platforms.

Video-enabled cell phone and mobile networks, for example, are much more bandwidth-limited than broadband Internet networks. Less bandwidth requires slower frame rates. Altered frame rates can throw off sound-to-picture synchronization. Screen sizes are smaller; graphic overlays that look great on-air disappear on the 176 x 144-pixel screen of a 3GP device. Soundtracks with a wide dynamic range suitable for theatrical release may go from inaudible to painfully loud on ear buds.

More Transcoding Terminology *continued*

MP3 — MPEG-1 Layer 3 audio codec. MP3 files are the basis of online audio file sharing.

MPEG-1 — A container format that includes three compression standards pertaining to synchronizing and multiplexing video and audio into a program stream; a codec for progressive, non-interlaced video; and an audio codec with three layers of complexity, the best known of which is MP3 (MPEG-1 Layer 3 audio). MPEG-1 was originally designed for use with video CDs, but found traction as an online video format in the 1990s.

MPEG-2 — A format that has two container types: TS (transport stream) and PS (program stream). The former is for video, audio and data used in broadcast applications. The latter is for more stable delivery environments such as DVDs. TS and PS both utilize the H.262 video codec, but impose different sets of constraints on parameters such as image resolution, frame rate and data rate to accommodate their respective delivery platforms' characteristics.

MPEG-4 — A container format with 23 parts, a number of which are still in development. MPEG-4 Part 2 is a video codec that has largely been superseded by MPEG-4 Part 10, aka AVC (Advanced Video Coding) or the H.264 video codec. MPEG-4 Part 2 is the codec of choice for DivX, Nero Digital and QuickTime 6; MPEG-4 Part 10, AVC/H.264 is the codec of choice for HD DVD, Blu-ray Disc, QuickTime 7 and Flash 9 among others. MPEG-4 Part 3 is a set of audio codecs, including the Advanced Audio Coding (AAC) codec, which was carried over from the MPEG-2 standard. MPEG-4 is being used in delivery media ranging from mobile devices to high-definition disc formats, in broadcasting, and so on.

MXF — A container format — MXF stands for Material eXchange Format—designed to hold Advanced Authoring Format meta-

But extremely different bandwidth conditions aren't the only factors illustrating the importance of format conversion. The migration from standard definition to high definition television provides a case-in-point. In the early days of HD broadcasting, it was common for networks to insert 4:3 SD commercials into their 16:9 HD MPEG-2 transport stream. Depending on how the stream was being displayed, the viewing experience ranged from horrible to disappointing. Some display devices attempt to upsample the SD content by simple pixel doubling or pixel stretching. Others leave the SD content alone and frame the 4:3 aspect ratio SD image in black. All of these techniques can leave consumers wondering why their expensive new HD TVs seem to be broken.

Similar format issues are legion. Content shot at 1080i HD resolution that is being broadcast by a network standardized on 720p needs to be downsampled and deinterlaced. Most HD production formats, for example, capture 10-bit per channel video, whereas compressed delivery formats like MPEG-2 only use 8 bits per channel. Ten-bit video has a range of 1024 steps between white and black; 8-bit has 256. Properly converting 10-bit per channel video to 8-bit per channel video minimizes visible banding in gradients via dithering.

SD and HD formats define color differently. SD defines color based on the ITU-R BT.601 standard; HD uses the ITU-R BT.709 standard. Both standards rely on 4:2:2 color sampling, but HD sampling rates are up to 5.5 times higher than SD color sampling rates. Visible color shifts result if color space is not accurately accommodated during transcoding.

When Format Conversion is Critical

Video and audio transcoding comes into play at each step of content creation, from production through delivery. In production and post-production environments, newly introduced file-based acquisition formats may not be natively supported by all nonlinear editing systems. Panasonic DVCPRO HD, for example, requires conversion to AVI or other formats to be compatible with some NLEs and direct-to-disk recorders. The Grass Valley Infinity camera is format-agile, however one of its acquisition formats, Motion JPEG-2000, must be transcoded to Canopus HQ to be compatible with Grass Valley's own Edius NLE system.

Accurate transcoding is also crucial when handing off SD or HD content from the edit suite to broadcast playout servers when you need to deliver content in both NTSC and PAL. As common as this conversion is, it's still difficult to perform well. Frame rates need to be converted; motion and scan line conversion artifacts minimized. MPEG-2 transport streams may be required for SD and HD content, while some satellite services may require MPEG-4 AVC/H.264 transport streams for the HD content.

More Transcoding Terminology *continued*

data, enabling workflows between non-linear editing systems that support AAF and cameras, servers and other systems that support MXF. Supported codecs include DV, IMX D10 and Broadcast WAV audio, among others.

PCM — Pulse-code modulation is the standard analog-to-digital audio conversion technique used in the Red Book compact disc format.

QuickTime — A container format that can accommodate nearly any type of media including animation, music, speech, text, video and much more. H.264 and AAC are among the video and audio codecs supported.

RealAudio — Proprietary audio container format developed by Real Networks that uses a variety of audio codecs, ranging from low-bitrate formats that can be used over dialup modems, to high-fidelity formats for music. RealAudio is usually packaged with RealVideo in .rm container files.

RealVideo — A proprietary video format developed by Real Networks that runs on a wide variety of platforms, including Windows, Mac, Linux, Solaris and several mobile phones. It is usually packaged with RealAudio in .rm (RealMedia) container files. RealVideo was originally based on the H.263 codec. With the release of Real Player 8, Real Networks switched to a proprietary video codec.

VC-1 — Developed by Microsoft and at least 15 other companies, VC-1 a variation on the H.264 codec designed to a handle interlaced video content without first converting it to progressive. VC-1 decoding is required in both the HD DVD and Blu-ray Disc players. VC-1 is also the official video codec of the Xbox 360. Microsoft has implemented VC-1 in three different codecs: WMV3, WMVA and WVC1. WMV3 implements the Simple and Main profiles of VC-1 for streaming

Delivering content shot on, say, miniDV tape and saved as QuickTime files over a corporate intranet via Flash Player may require it to be deinterlaced and transcoded to one of several video and audio codecs supported in the Flash container, such as On2 VP6 for video and AAC (Advanced Audio Coding) for audio.

Leveraging secure streaming and progressive download delivery formats and platforms for video on-demand applications present still other challenges for enterprises and facilities of all sizes with high-volume demands: compositing logos and watermarks that are scaled to match a variety of screen sizes and aspect ratios; inserting ads that match program content size, resolution and aspect ratio; tracking rights and permissions; and Closed Captioning are just some of the tasks that come to mind.

Rhozet Solutions

Rhozet™ Carbon Coder is a powerful universal transcoding application with support for virtually all major input and output formats. Carbon Coder can run as a standalone desktop application for moderate transcoding needs. Its flexible, scalable architecture allows Carbon Coder in conjunction with Carbon Server to form a multi-nodal, distributed network transcoding farm to handle the most demanding, high-volume transcoding workflows.

Carbon Coder runs under Windows XP and leverages the latest high-speed, multithreaded, multi-core CPU technologies. Carbon Coder can be operated from its own user interface, via the customizable XML-based API included with the product, or remotely from the web-based interface in Carbon Server. The same API controls both Carbon Coder and Carbon Server, so you can develop on a single copy of Carbon Coder and scale your transcoding farm with ease by uploading the XML-based customization to an unlimited number of Carbon Coder nodes to accommodate increasing workloads.

Carbon Server supports an unlimited number of Carbon Coder engines with load balancing. A base system is a 5-node rendering farm consisting of a single node of Carbon Server and four Carbon Coder nodes. Rendering farms can be configured so that one or more Carbon Servers controls them. Distributed enterprise transcoding with Carbon Server provides maximum flexibility, future-proofing and cross-vendor interoperability for a broad range of business environments, from boutique post-houses to enterprise-scale organizations.

Comprehensive Format Support

Among the formats supported by Rhozet technology are acquisition formats ranging from SD to DV25 and DV50, HDV to HD, DVCPRO and DVCPRO 100 to Sony XDCAM; MPEG-2 and MPEG-4 SD and HD transport

More Transcoding Terminology *continued*

and downloading. It is used in Windows Media Video 9. HD movies released in the WMV HD format use VC-1 MP@HL encoding. WMVA (the A stands for Advanced) was distributed as part of Windows Media Player 10 and is not fully VC-1 compliant. WVC1, also known as Windows Media Video 9 Advanced Profile, is reported to encode interlaced content of the same quality at one-third the bitrate of MPEG-2.

VOB — Video Object is a container format utilized in DVD-Video media. VOB is based on MPEG-2 program stream format.

WAV — Waveform Audio Format is the main format used on Windows systems for raw and typically uncompressed audio. The default bit stream encoding is the Microsoft Pulse Code Modulation (PCM) format.

Windows Media — Multimedia framework developed by Microsoft that supports a number of formats for media creation and distribution including WMA and WMV.

WMA — Windows Media Audio is a container format developed by Microsoft. It supports four codecs: WMA (developed as an alternative to MP3 and RealAudio); WMA Pro (a higher resolution codec that supports multiple channels); WMA Lossless (a lossless compression codec); and WMA Voice (a low-bitrate codec for voice content).

streams in H.262 and AVC/H.264 codecs for broadcasting; editing and archival formats such as ASF, Canopus DV and HQ, MXF (including Quantel sQ), GXF, LXF and QuickTime; Web and mobile formats including Flash, WMV, RealVideo, MPEG-4, 3GPP; and DVD formats including MPEG-2, MPEG-4 AVC/H.264, VOB and VC-1.

Currently supporting more than 40 input and output formats, Rhozet Carbon Coder is continually being updated to accommodate emerging formats.

Carbon Coder ingests nearly every format it outputs. The only exceptions are a small number of still image sequence formats such as PSD, PICT, QT image and SGI. Analog and SDI ingest is supported via off-the-shelf, third party hardware from such companies as Blackmagic Design, Matrox and others.

A comprehensive list of containers and codecs supported by Carbon Coder can be found at www.rhozet.com/Rhozet_formatGuide.PDF.

Rhozet Tasks

The Rhozet engine can perform a variety of tasks, either administrative or actual transcoding jobs. In its simplest form, a task always has one command descriptor and, in the case of queuing a transcoding job, for example, one or more source files and one or more destinations (a target file with its encoding parameters).

JobEvaluate — Evaluate an XML structure, gather information about source files, and so on.

JobQueue — Submit a Job for execution or queuing.

JobList — Return a list of current running or queued jobs.

JobCommand — Allow a caller to query for information and to start, stop, delete, and so on queued, running, or completed conversation jobs.

WatchCreate — Establish and activate a watch folder.

WatchList — Return a list of currently active watch folders.

WatchCommand — Query for watch folder information and remove and modify watch folders.

Other Essential Operations Performed by Carbon Coder

In addition to essential transcoding processes such as frame size conversion, advanced frame rate conversion, color space conversion, aspect ratio conversion, interlace/de-interlace conversion, telecine/inverse telecine, PAL/NTSC conversion, SD/HD conversion and cropping, Rhozet Carbon Coder and Carbon Server perform a host of essential video and audio operations. These include video processing functions, audio processing and a variety of other operations listed here.

Video Processing

Fade In/Out – Applies a fade in and/or out to your video in order to aid the encoding process. Use this filter if your source video has a lot of fast motion in the first few frames. The fade in gives Carbon Coder a “running start” so it can encode your video more efficiently.

Black/White Correction – Lets you adjust and control the levels of black and white pixels in your video. By adjusting the sliders, you can specify at which point a pixel will become black and/or white. The higher the setting, the more nearly black pixels will be converted to true black and vice versa. This works best if you are encoding video for the Web and need to adjust the black and/or white levels of broadcast video so that they are truly black or white. It’s also useful for making white titles on a black background more legible when viewing on a computer monitor.

Blur – Blurs video in a rectangular pattern.

Audio Processing

Normalize – Raises audio to maximize volume without clipping. Adjust the volume of a batch of clips so they are all at the same level. This is a dual-pass filter and will increase your source file’s overall conversion time.

Audio Fade In/Out – Add a fade in and/or fade out to the audio. This is most useful in conjunction with the Video Fade In/Out filter.

Lowpass Filter – Removes high-frequency signals, such as electrical noise and hiss, from the audio.

Volume – Adjusts amplitude levels.

Compression – Alters perceived volume by reducing or limiting dynamic range of audio signals.

Color Correction

Gamma Correction – Adjusts gamma settings. NTSC-safe.

Median – Designed to improve picture quality by removing single-pixel defects without affecting the sharpness. Similar to a despeckle filter.

Rotate – Provides 90-degree rotation and axis flipping.

Sharpen – Sharpens video using the “unshapen mask” technique.

Temporal Noise Reducer – Effective for removing analog noise.

Additional Operations

Timecode Imprint – Burns timecode into files.

Subtitle/CC Imprint – Adds Subtitles and Closed Captions.

XML Controllable Titler – Generates titles automatically from XML databases.

Metadata Transport and Conversion – Supports and converts metadata formats.

Line 21/CC Insertion/Extraction – Insert or extract EAI-608 compliant Close Caption information.

Watermarking – Embed a watermark in your content to insert ownership or copyright data.

Logo Insertion – Insert a logo in your video content.

Native Processing in 4:2:2 Y’CbCr and RGB – Manage color spaces in their native format.

601/709-Color Space Support – ITU-R BT.601 and 709 standard SD and HD color space support.

Multiple Machine Transcoding

Both Carbon Coder and Carbon Server utilize grid computing to exploit the extra computational resources of multiple CPU machines, multi-core CPUs and distributed computing networks with as many CPUs as you need. This greatly reduces rendering wait times by distributing rendering across however many CPUs are available.

By employing multiple CPUs simultaneously, render times are greatly reduced.

In the case of some formats that render one thread at a time — Flash, MPEG-2, MPEG-4 AVC/H.264 and VC-1, for example — macro grid computing allows you to divide a file into a user-definable number of segments and assign each to a different CPU for rendering, then stitch them back together. Technically speaking, rendering is no faster on any single CPU.

Carbon Server allows you to optimize your load balance point across multiple CPUs. Watch folders allow you to monitor automated workflow, tracking files as they are ftp'd into the system by checking every n-seconds. As new files are received, transcoding begins. When a file is complete, the system sends an email or Web notification. Notifications can be customized via the API.

A new tool called Carbon Admin lets you connect to the API locally and gives you control over such things as watching the queue, launching jobs and creating watch folders. The API provides incredible flexibility by bypassing the user interface and giving you direct control over all aspects of the program. Carbon Admin is an essential interface for controlling the API.

Network watch folders can be named, assigned multiple notifications, set up to perform multiple file retrievals to look at a UNC (universal naming convention) path, a network share, an ftp site, and so on. Watch folders can be created to watch other watch folders, check multiple locations, transcode to multiple outputs, each output can be sent to multiple locations... the possibilities are completely customizable.

Four different types of logs are created and maintained to help administrators monitor events. The Carbon Coder engine itself is a service that runs on your system. Its settings allow you to track the number of available slots, set job priorities, specify the number of jobs to keep in a queue, and stipulate a default email address for notifications. Machines with hardware acceleration can be tagged to handle media specific to the type of accelerator. Terari board-equipped machines, for example, could be tagged to handle any Windows Media VC-1 files that are put into a transcoding queue.

About Rhozet

Since 2004, Rhozet, a business unit of Harmonic Inc, has focused on designing scalable, high-performance, universal media transcoding technology for delivering content in any format, at any time, on any device, smoothly, efficiently and in the most cost-effective manner possible. Rhozet began as part of Canopus and operated as an independent company from 2005 until August 2007, when Rhozet was acquired by Harmonic, a manufacturer of enterprise-class hardware encoders. In addition to its enterprise transcoding products, Carbon Coder and Carbon Server, Rhozet is the developer of the popular desktop transcoding applications ProCoder and ProCoder Express, which have been marketed and sold under the Grass Valley brand since its acquisition of Canopus.

About the Author

Dominic Milano is the principle of DM&C, a company that provides content creation and consulting services in a variety of markets, including video, music and sound design, game development, interactive design, 3D modeling and animation and related creative fields. Dominic has over 30 years of experience in print, online and event media production, working on *DV* magazine, *DV.com*, *DV Expo*, *Game Developer* magazine and the Game Developer Conference, *Keyboard* magazine, *Guitar Player* magazine and more.

Automated QA looks at letter boxing, dropped frames, audio dropouts, macro blocking and so on. If any of the parameters has an error in it, the file gets flagged so it can be examined.

Performance Considerations

There are three factors that will affect system performance: processor speed, system memory and storage. Buss and RAM speeds play a role, but it varies by codec. In general, to achieve best results, use the best CPUs and storage available. Other ways to maximize performance include defragmenting your source and target hard drives, and using separate hard drives to access source files and writing target files. To assess your transcoding needs and specify a transcoding computer, refer to the tables in the following "Benchmarks" chart.

Benchmarks

The chart on the following page is a reference for how fast Rhozet Carbon Coder transcodes from specific sources to some of its standard presets. The list of files across the top represents the source content, including standard definition NTSC MPEG-2 transport streams at 3 and 15 mbps, a 1080i NTSC 50mbps MPEG-2 transport stream and a DV25 file. The Carbon Coder output presets are listed down the left-hand side. The presets can be found in the application, so you can employ them to benchmark your hardware.

The machine used for all of the following tests was a Dell T7400 with two dual-core Intel 5260 3.33 GHz processors, 8 GB RAM, and separate 15K SAS drives for source and target files. The operating system was Windows XP 64-bit edition. Each source file was transcoded individually to each target file listed.

The results for each transcode are recorded as a factor of real time (RT). The source files were each the exact same video content with a 300-second duration. To calculate the encoding rate, the source duration (300 seconds) is divided by how long it took for the file to completely transcode. For example, if the transcode took 300 seconds to complete, then the calculation would be 300 / 300 for a result of 1.00 x RT. Likewise, if the transcode took 60 seconds to complete, then the calculation would be 300 / 60 for 5.0 x RT or five times faster than real time.

Put another way:

(Source Duration) / (Transcode Duration) = Rate of RT.

You can use this rate to calculate how long it will take to transcode your files by using the following formula:

(Source duration in seconds) / (Rate of RT) = Transcode Duration

Carbon Coder Benchmarks		3mbps SD MPEG-2 TS	15mbps SD MPEG-2 TS	25mbps DV	50mbps HD MPEG-2 TS
Broadcast	ATSC HD	0.569	0.588	0.571	0.595
	ATSC SD	1.899	1.948	1.923	0.723
	CableLabs 1080i	0.512	0.515	0.514	0.802
	CableLabs 720p	0.562	0.578	0.568	0.617
	CableLabs 3/4 Screen	2.362	2.362	2.381	0.802
	D10 OP1A	3.093	2.778	3.297	2.778
	GXF LongGOP 1080i	0.167	0.167	0.167	1.000
	GXF MPEG2 SD	3.448	3.333	3.529	0.674
	LXF I-Frame 1080i	0.168	0.168	0.512	1.327
	LXF DVCPPro25	6.818	5.882	7.500	0.754
	MediaStream LongGOP 1080i	0.166	0.166	0.166	0.965
	MediaStream LongGOP SD	5.172	4.688	5.882	0.616
	MediaStream I-Frame SD	6.383	5.357	7.500	0.693
	Omneon LongGOP 1080i	0.165	0.165	0.166	0.949
	Omneon LongGOP SD	3.000	2.941	6.383	0.668
Quantel OP1A SD	3.371	2.970	3.571	0.661	
DVD	Preview DVD	5.357	4.839	5.882	0.698
	MPEG-2 PS SD	4.054	4.054	4.110	0.730
	DVD - Mastering Quality	1.167	1.181	1.190	1.266
Editing	DV	8.824	7.317	10.345	0.560
	P2 DVCPProHD 1080i	0.713	0.716	0.721	0.977
	P2 DVCPPro50	3.191	3.061	3.297	0.690
	XDCam MPEG2 1080i	0.393	0.394	0.396	1.115
	XDCam DV25	4.839	4.478	5.263	0.721
Mobile	3GPP H.264 320x240	10.345	7.500	10.714	1.546
	iPhone 640x480	3.659	3.448	3.704	1.277
	iPhone 320x240	4.762	4.762	5.263	1.345
	iPod Classic Low Res	5.000	5.085	5.357	1.648
	iPod Classic High Res	2.055	2.055	2.098	1.538
	Zune 320x240	2.970	3.000	5.172	1.579
	Zune 640x352	1.014	1.014	1.038	0.765
Web	Flash 9 852x480 1.3mbps	1.786	1.630	1.714	1.154
	Flash 9 720p 4.1mbps	0.694	0.670	0.696	0.726
	Flash 9 432x240 500kbps	3.371	3.947	4.412	1.613
	Flash 8 852x480 1.3mbps	0.993	0.971	0.912	0.843
	Flash 8 720p 4.1mbps	0.601	0.586	0.587	0.624
	Flash 8 432x240 500kbps	2.727	2.632	2.885	1.456
	MP4 H.264 852x480 1.3mbps	1.685	1.630	1.724	0.977
	MP4 H.264 720p 4.1mbps	0.694	0.435	0.698	0.726
	MP4 H.264 432x240 500kbps	2.439	2.344	2.521	1.435
	VC-1 852x480 1.3mbps	0.609	0.601	0.616	0.485
	VC-1 720p 4.1mbps	0.282	0.279	0.283	0.311
	VC-1 432x240 500kbps	1.003	1.010	1.031	0.769