

Analog-to-Digital Video Conversion

What desktop publishing did for the production of printed materials, desktop video will inevitably do for the production of digital movies. Entering the millennium, all of the requisite hardware components are available, and powerful computer software tools, with professional capabilities, are within the reach of both casual and serious digital videographers.

There are several inherent problems with digital video, however. First is the size of the files that it produces. Full motion video runs at 30 frames per second (fps), or 1800 frames per minute (fpm). Even at relatively low quality video, in a modest frame size, it can require approximately one gigabyte of hard drive space for every 4.75 minutes of video.¹

Second is the problem of capturing the video images into the computer. There must be a way to move stored or live video images, in either analog or digital format, from the capture device (video camera), video player (VCR, DVD player), or live video feed, into a computer for storage and processing.

Third is the problem of managing the video elements, editing them, adding music and voiceover, inserting transitions and special effects, creating titles and credits, and otherwise producing a cohesive, engaging production.

Fourth is the problem of outputting the completed video production in a form that can be viewed by an audience.

Just as in the mid-1980s, when the technologies embodied in the Apple Macintosh computer, Aldus PageMaker software, and Adobe PostScript

page description language, all worked together to democratize the process of print production, and provide desktop publishing technology to the masses, desktop video has been unleashed by the following developments:

- Powerful and versatile non-linear editing (NLE) software, some incorporating the capabilities of proprietary, dedicated high-end editing systems, has been made available for use on off-the-shelf personal computers. Programs such as Adobe Premiere and Apple Final Cut Pro are being used for motion picture and broadcast television productions, despite the fact that they are also available to consumers and other nonprofessionals.
- Typical personal computer systems now have the computing power, storage capacity, and screen size to support desktop video production.
- As in the field of desktop publishing, Apple Computer has provided industry-leading innovations, in the form of:
 - FireWire,² Apple's replacement for SCSI, which enables easy, and most importantly, fast, communication between the computer and a wide variety of peripherals, such as a digital video camera. Transfer occurs without decompression or recompression, providing an exact digital copy, which is maintained in its native form during storage and manipulation.
 - iMac, Apple's self-contained, easy-to-use computer system, which has built-in FireWire, and all of the components to support desktop video.
 - iMovie, a breakthrough desktop video production application that is easy enough for children to use, yet sophisticated enough for adults to produce professional-quality video productions. iMovie is provided at no cost on Macintosh computers.
 - Final Cut Pro, a software application priced under \$1000 that incorporates most of the functionality of dedicated

¹A standard analog television signal is composed of three parts. First is the color depth which is 32-bit, RGB. Second is the resolution, which is 525 lines of resolution for broadcast television, 240 lines for VHS tape, and up to 500 lines from a digital camcorder. Third is the frame rate, which is 30 frames per second for broadcast television.

²Also known as IEEE 1394. Sony calls its implementation iLink.

systems costing orders of magnitude more.

- The Apple SuperDrive, a combination DVD-R/CD-RW, drive that provides the user with the capability to produce a DVD disc that can be used on most consumer DVD players, or on any computer with a DVD drive.
- iDVD, an easy-to-use application for producing DVD video discs that can be viewed on either a DVD player or computer.
- DVD Studio Pro, a professional interface design environment for authoring sophisticated DVD projects.
- Apple DVD-R media, holding up to 4.7GB, and available in quantity for under \$10 each, making DVD production more affordable than it has ever been.
- Consumer and prosumer digital video cameras have dropped well below \$1000, with some models below \$500. As significant as their price drops is the fact that manufacturers have incorporated easy-to-use technology to connect them to personal computers.

Digital video is the way that video is moving. Video stored in digital form has several advantages over its analog counterpart. These include:

- No degradation in quality when dubbing (copying) video elements. Each successive generation maintains the same quality of the original.
- Digital video can be transferred to a digital editing system without the need for conversion of any kind.
- Digital electronics incorporate error correction circuitry that compensate for lost or missing data.³
- Digital video can be edited using sophisticated editing tools allowing the videographer to be both creative and productive. In addition,

the video elements can be reused and recombined in any way, at any time.

- Digital video supports the application of special effects that can not be produced in any other way.
- The digital video process is nondestructive. The videographer can experiment with an unlimited number of copies without risking the loss or destruction of the original footage.
- Digitally encoded video can be stored on DVD and on other formats that have extended archival lives. This type of media is more compact, and more durable than videotape.
- Digital video can be delivered on-line, on-demand through local networks, intranets, or the World Wide Web.
- Digital video can be written to removable media, such as DVD, which incorporates advanced viewing options, such as scene selection and alternate sound tracks. In addition, digitally encoded video has higher quality than the analog format.
- Digital video is nonlinear, meaning that any scene or video clip can be accessed randomly without regard for its physical location in the production. Analog video, in the form of videotape, is linear, meaning that in order to locate a scene at the end of the tape, the user must bypass all preceding footage.

The Editing Process. The video editing process involves locating and saving the good footage, arranging it in the proper sequence, and enhancing it with appropriate titling, transitions, special effects, music, and narration. Although many video cameras provide some in-camera editing capabilities, the flexibility, expandability, and control available in a desktop non-linear editing system is unsurpassed. See *The Handbook of Digital Publishing*, Vol. II, pages 287-298.

³A single videotape video frame is recorded on a length of tape that is approximately equal to the width of a human hair. The read/write heads that record and read these areas spin at a speed of about 9000 rpm. Given these tolerances, a speck of dust can result in a dropout, or area of missing data. The missing data is reconstructed by error correction software

on the basis of an analysis of the contents of adjacent data blocks. In an extreme case, in which one or more frames can not be reconstructed, the digital logic will copy the last good frame over all bad frames resulting in what appears as a series of frozen frames. (Module 48: Professional Video Formats, <http://www.cybercollege.com/tv048.htm>.)

Inevitably the digital video editing process will involve either legacy footage or contemporary video input that is in analog format. Analog video must be converted to digital video format in order to be used on a computer. Since analog video preceded digital video, analog-to-digital video converters are fairly commonplace, since they were once the only means of importing video into a computer. Today there is a significant need to combine analog video with digital video, and output it in either digital or analog format.

Despite the benefits of the digital format, and maintaining a production solely in a digital format, there are compelling reasons to output to analog videotape. The prime reason is that videotape is still the prevalent video storage medium, found in most homes, schools, organizations and businesses. According to the International Recording Media Association, as of the end of 2000 more than 200 million VHS (Video Home Service) units were owned by 93 million U.S. households.⁴ Although the use of the DVD format is growing rapidly, video rental stores are still primarily VHS tape-based, since most of their customers still use VCRs.⁵

The product of the digital video production process must be displayed in some form, analog or digital. If it will be broadcast,⁶ or recorded to VHS tape it will be analog; if it is burned on DVD or CD for display on a computer, or streamed on-line for on-demand viewing, it will be digital. Since analog sources and destinations remain such an important part of the video production process, users must have the means

⁴Speech by Charles Van Horn, President, International Recording Media Association (IRMA), REPLItech North America, Tuesday, June 13, 2000, Miami Beach, Florida, <http://www.recordingmedia.org/statistics/speech-june-2000.html>

⁵Total sales of DVD players in the U.S. reached 13 million by the end of 2000, with sales predicted to reach 31 million by the end of 2003. DVD is the fastest growing new media format in history according to the International Recording Media Association. (Speech by Charles Van Horn, President, International Recording Media Association (IRMA), REPLItech North America, Tuesday, June 13, 2000, Miami Beach, Florida, <http://www.recordingmedia.org/statistics/speech-june-2000.html>)

to easily and reliably import and export it. One of the best and most cost-effective methods to do so is the Dazzle Hollywood DV-Bridge⁷ for Macintosh and PC computers.

The Dazzle Hollywood DV-Bridge. The Dazzle Hollywood DV-Bridge is a compact, stand-alone device that provides analog-to-digital or digital-to-analog conversions through the use of two sets of inputs and outputs (FIG. 1). These connections consist of the following:

Dazzle Hollywood DV-Bridge Hardware Connections (FIG. 2)

Front Panel	Back Panel
Mode Indicators	Mode Selector
Composite Video In	Composite Video Out
S-Video In	S-Video Out
Audio In (L)	Audio Out (L)
Audio In (R)	Audio Out (R)
1394/FireWire/iLink	1394/FireWire/iLink
	LANC
	Power



FIG. 1: The Dazzle Hollywood DV-Bridge is a compact converter for importing video into, and exporting video out of, a personal computer. The unit sells for \$299.99.

⁶Although high-definition television (HDTV) is coming, most television is the same 1960s analog standard.

⁷Dazzle Incorporated, 47211 Bayside Parkway, Fremont, CA 94538, 510 360-2300, <http://www.dazzle.com>, fax: 510 360-0211.

The Dazzle Hollywood DV-Bridge is autosensing, and adjusts itself to the proper mode based on the connections that have been made. On the basis of the connections, the unit will set itself into one of its three states: Digital to Analog, Pass Through, or Analog to Digital. Each of these states corresponds to an LED mode indicator located at the top of the device.

Although the unit is generally used to import video into, or export video out of, a personal computer, it can be used directly between analog and digital devices, without a computer. For example, if the video does not need to undergo editing, it can be copied directly between the source and destination. In this case the user would need to manually use the Mode Selector button

to enter the proper conversion mode.

Any video transfer can be initiated using an attached TV monitor to preview the video in realtime. Although a transfer that goes to the computer will most likely show the incoming video on the computer screen, seeing it on a TV monitor shows how it will ultimately appear when output in standard video format. Connections are made from the monitor's video and audio inputs to the DV-Bridge's Video Out using either a composite video or S-video cable, and to its Audio Out using RCA audio cables.

Video that is being captured on a computer can be controlled by using the record or capture function in the digital video editing software.

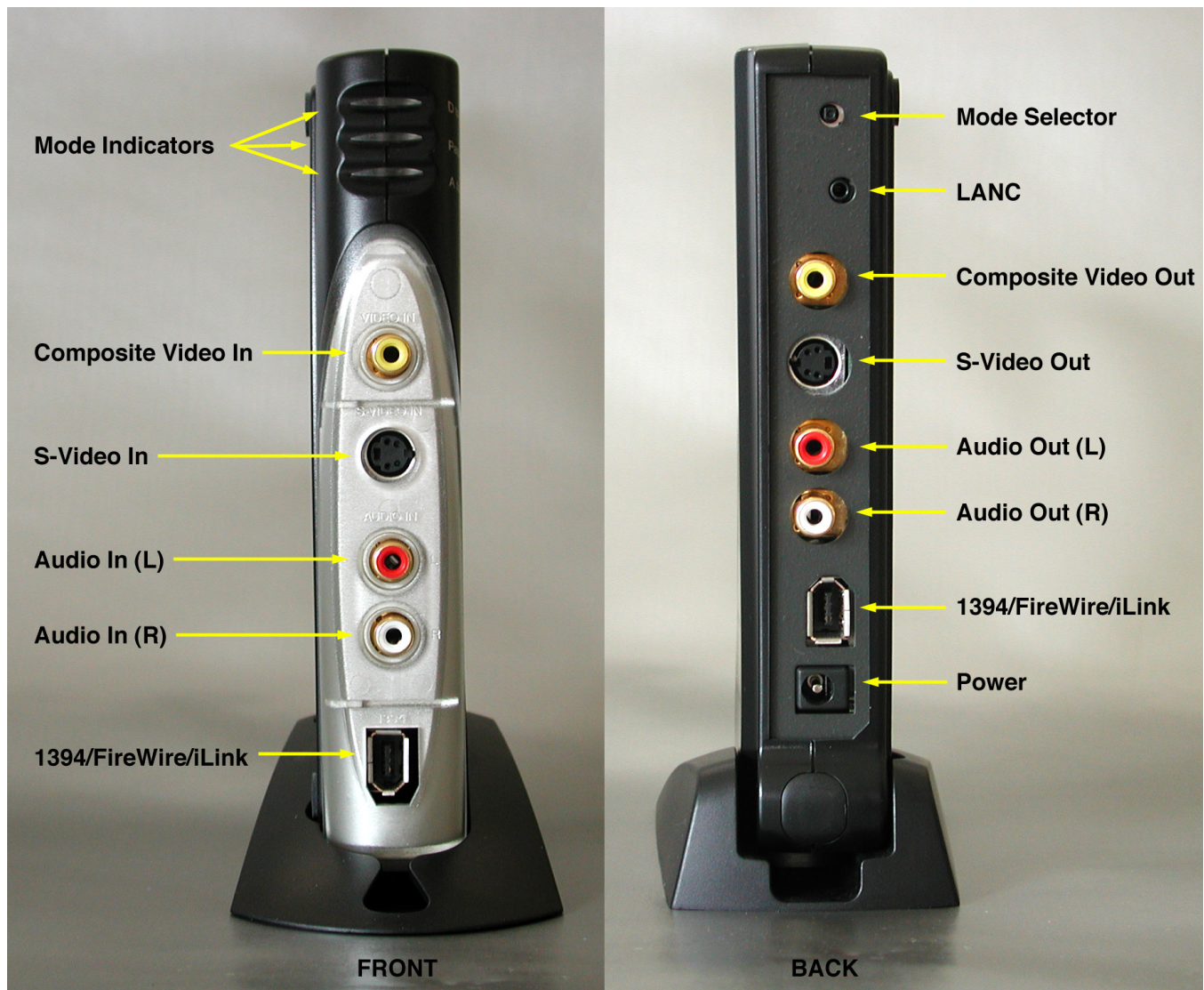


FIG. 2: The connectors on the front and back of the Dazzle Hollywood DV-Bridge video converter provide for very flexible and easy video conversions.

If the source is a videotape, the source device must be set to the VTR mode on a DV or analog camcorder, or the play mode on a VCR. The DV-Bridge also has a LANC (also called Control-L) connector on the back that can interpret compatible DV camcorder LANC protocol control codes, and allow the video editing software to control the camera. The Dazzle Hollywood DV-Bridge can also capture live video if the camcorder is set to camera mode, or if a standalone video camera is connected directly to the DV-Bridge.

The Dazzle Hollywood DV-Bridge also has a pass through mode whereby FireWire from the source

device goes directly to a FireWire destination. Normally this will be a DV camcorder input going to a computer output, but it may also be on DV camcorder connected to another DV camcorder, and eventually alternate outputs, such as DV Recorders will be available. Although FireWire connections between the DV camcorder and computer could be made directly, the pass through is provided for convenience so that the FireWire cable, which is provided, can remain connected to the computer.⁸

⁸*A single FireWire cable is the only connector provided with the Dazzle Hollywood DV-Bridge. The user must provide all other cables.*