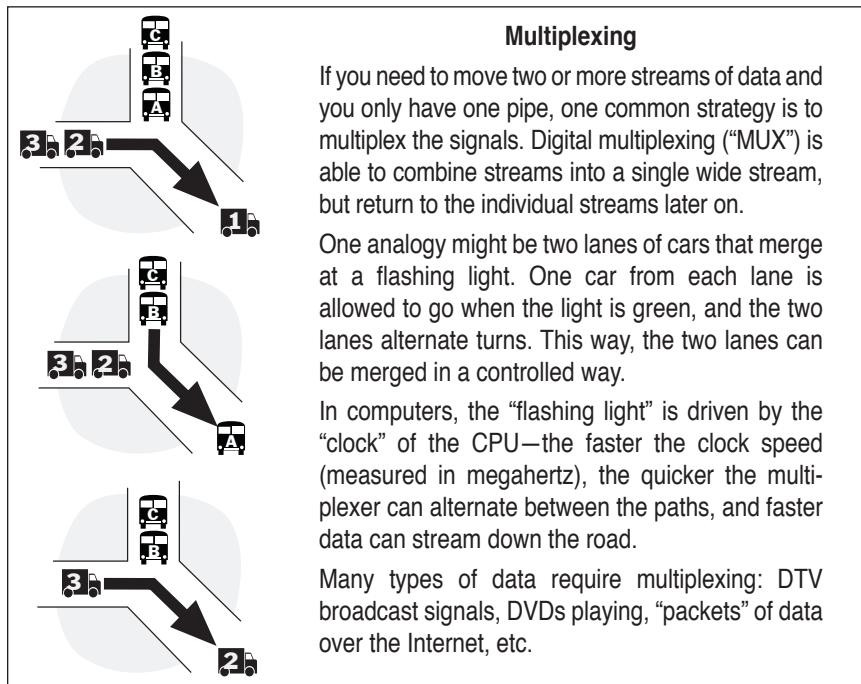


with sidebar textural commentary; commercials with product ordering capabilities; databases with short video clips in fields; stories that flow passively or fork based on user input . . . but these aren't the *future* of video on the web. *That* hasn't been invented yet.

All we can say is that we are looking at the things that will evolve into what it will be; and it won't be like what have now. The media of the Internet has yet to be invented, but it will likely involve many of the things discussed here, and it will be created with many of the tools articulated in this book.



The convergence of television and the Internet creates the need for authoring capabilities for hybrid entertainment media. This Avid Symphony prototype (circa 1998) featured an “interactive programming” track, here labelled IP1. The functionality could be used to trigger web pages in sync with a television program (when viewed on WebTV-style set-top boxes), or with a video program (when seen in a frame on a web page).



D V D

It looks like a standard CD audio disc; it functions a great deal like a CD-ROM. The initials “DVD” originally stood for things: some people said *Digital Video Disc*, but also *Digital Versatile Disc*—now the initials officially don't stand for anything. DVD is the first distribution medium for digital, random-access and interactive video for the mass market.

The DVD format is backward compatible with the CD-ROM format, which means that a DVD player will play a CD-ROM (and CD-audio) disk, but not the other way around. Consequently, since CD-ROM players cost about as much as DVD players (which *do* a lot more), computers today are rarely delivered with CD-ROM drives; at the beginning of the new century, most PCs were built with DVD players in them. *Set-top* DVD players are a different industry, though, which unfortunately creates a dichotomy of DVD use and functionality in the medium.

DVDs in a *computer* are playing on high-resolution displays with progressive scanning, and are probably connected to the Internet (with a reasonably high-speed connection). The DVD can outperform web streaming video, if desired, and (in “eDVDs”) can seamlessly augment this pre-recorded disc with current metadata from the Internet. On the other hand, a DVD set-top box plays through a *television*, with lower resolution, limited screen area, and probably no Internet interaction.

Consequently, the design of material that goes on a DVD must either be targeted for one display method or the other, or downscaled to the lowest common denominator (the TV), as most are. This is one challenge of DVD creation and distribution.

Studios seem happy to release movies on DVD and treat it as comparable to making a dub for VHS video release. But in their focus on the disc as distribution medium, and closely watching expenditures beyond the bare minimum, they often miss the opportunity in the format. The disc is, after all, interactive. Should consumers so choose, and if given the chance, a great deal of interaction can be had.

Making DVDs

DVD *premastering* involves a number of steps, some of which are highly creative and others that are particularly technical. Simple interaction and menus are added quickly—often they're little more than a title card and some chapter stops. Like web or book publishing, DVD authoring is about preparing the materials for consumer interaction. Designing a user's expe-

rience. DVD authoring tools are remarkably similar to Web authoring tools; an author of a complex site or DVD would begin by mapping out the tree and hierarchy of “pages” and links. Graphics, buttons, titles, *etc.* need to be created and integrated. Sophisticated DVDs have considerable content in addition to the baseline streaming of the film: interviews, script pages, commentary, and so on. DVDs are also useful media for non-entertainment content (*e.g.*, educational materials, corporate communications) which are all well-suited to the high-quality video and user-controlled interaction. In many ways, today’s DVDs can model the Internet experience ideally possible with broadband (~4Mbps connections), and will serve to fill that niche for the many years before that broadband experience is widely available.

DVD Creation

Any video that is to play from a DVD needs to be encoded into a DVD-compatible format. Hardware or software is required to manage the video multiplexing and MPEG compression, and to generate the final “disc image” that ultimately finds its way onto a disc. This format conversion will increasingly be available as just one of a number of output options of any system managing digital video—in particular, from nonlinear editing systems. In much the way software like Photoshop works independently of file formats, but allows output in any number of options (*e.g.*, TIFF, JPEG, GIF), editing systems will output streams in DV, DVD, plain-ol’ MPEG-2, QuickTime or RealMedia.

The most creative aspect of DVD creation is in the building of the user’s experience. Elements for authoring must first be generated (edited sequences, title cards, any variety of graphics and content), and then a map needs to be conceived that moves users through the elements. Unlike most web links, DVD links have built-in intelligence that can make causal and temporal inferences from selections. For instance, a standard link might say “press this button and go here,” but a link with intelligence would say “press this button and go here, unless you’ve already pressed it three times before, then go *here*; or unless you have already seen this other screen, whereby you should go *over there*.” Increasing the sophistication of links means a more involved authoring process, but it creates a significantly more compelling medium.

As authoring systems continue to evolve, these tools become more streamlined, more graphical and intuitive, and more accessible to the non-technical creatives who will be developing innovative experiences.

DVD Anatomy

The various qualities that make DVDs unique fall into two distinct categories—**physical** and **logical**. Physically speaking, a DVD differs from a CD in two major respects:

- The bits are almost seven times as densely packed as on a CD.*
- Discs can be manufactured with *two* physical layers of information, and on both sides, yielding a total of up to 26 times the information on a disc that’s the same “form factor” (*i.e.*, size and shape) as a CD.

Thus, DVDs can be manufactured in a variety of configurations; they are named for their approximate capacities:

Name	Description	Capacity**
DVD-5	single-sided, single-layer	4.7GB (37,600 Mb)
DVD-9	single-sided, dual-layer	8.5GB (68,000 Mb)
DVD-10	double-sided, single-layer	9.4GB (75,200 Mb)
DVD-18	double-sided, dual-layer	17.0GB (136,000 Mb)

[Note: single-layer discs look silvery, like a CD; dual-layer discs have a golden appearance.]

In addition, the standard “single-speed” DVD drive is designed to spin the disc faster, and read about eight times more data off the disc per second, than a CD player or single-speed CD-ROM. Thus, it provides not just more capacity, but more “bandwidth” as well:

$$8x \text{ CD-ROM} = 1x \text{ DVD-ROM} \\ \text{or } 8 \times 1.3\text{Mbps} \approx 10\text{Mbps}$$

And that’s it. The DVD disc itself is just a bigger, faster CD.

Of course, there are other features of the DVD format that make it unique compared to CDs or VHS tapes. The most significant is its ability to provide interactivity—it lets you make menu selections, and more. In addition, video can approach D1 quality. And there are multiple angles, audio soundtracks and subtitles available to select from. So what’s involved in actually making a DVD of your finished, edited project?

On the logical side (that is, in terms of what’s actually recorded on the disc), things get interesting. Load up a standard DVD-video disc on a computer’s DVD-ROM drive, and you’ll see some big, arcane-looking files with strange names. *It’s this particular set of files, and the particular*

* You can see this for yourself just by looking: higher density means that a DVD reflects colors somewhat differently than a CD does when you hold it up to the light.

** In this unique case “1GB” refers to the metric (multiple of 1000), not the binary (multiple of 1024) number of bytes.

data that's contained within them, that gives the DVD its unique, interactive qualities.

This suggests an idea: couldn't you cram your own videos and menus into a set of files just like them, and then put those files on a hard drive, or burn them onto a CD-R, or maybe even email them? *You bet!* While this doesn't mean that a standard DVD player would read them (you'd need to create a *bona fide* DVD disc for that), it does open up a range of possibilities for anyone with access to those files and DVD player "emulator" software on their computer—which many computers now have. DVD is both an object (the disc) and a type of file format. This is an important distinction.

Name	Size	Type
Video_ts.vob	9,688KB	VOB File
Vts_01_0.vob	4,192KB	VOB File
Vts_01_1.vob	1,048,508KB	VOB File
Vts_01_2.vob	1,048,256KB	VOB File
Vts_01_3.vob	1,048,344KB	VOB File
Vts_01_4.vob	644,766KB	VOB File

Part of a DVD file directory

The Nitty-Gritty

Creating a DVD means figuring out what you want the viewer to be able to see and do, and when, and then converting that into a form that the DVD player or software is able to recognize and play back. Here's an outline of the *premastering* process:

Asset management: Create and/or gather up all the different types of source files to be included on the DVD (video, audio, menu graphics, subtitles, stills, etc.).

Navigation: Figure out what menu screens you want to have, and what the viewer will have access to when clicking on each button. Much like designing the hierarchy of pages on a website.

Bit Budgeting: Tally up how much total "stuff" you've got, what capacity disc you're going to put it onto, and then figure out the highest quality video you can get, within those limitations. This is a little like playing "The Price Is Right"—you want to fill up the disc of your choice as close to capacity as possible, but without going over.

Encoding: Convert the video, audio, etc., into the types of "elementary streams" that DVD software and players expect to see. For video, this is some form of MPEG. For audio, there are several choices, including Dolby Digital, MPEG, and PCM.

Authoring: Import all the project's various assets into a specialized piece of software. (Menus and subtitles, generally created as TIFF or PICT files, are converted here into high-quality "MPEG stills.") Next, create links between the menu buttons and the individual videos. Add chapter points and other kinds of interactivity.

Proofing: "Beta" test the whole experience yourself and with the help of others. Debug stuff that doesn't quite work right.

Multiplexing: When everything's decided, export all of that digital data into the mysterious files that get written to the disc.

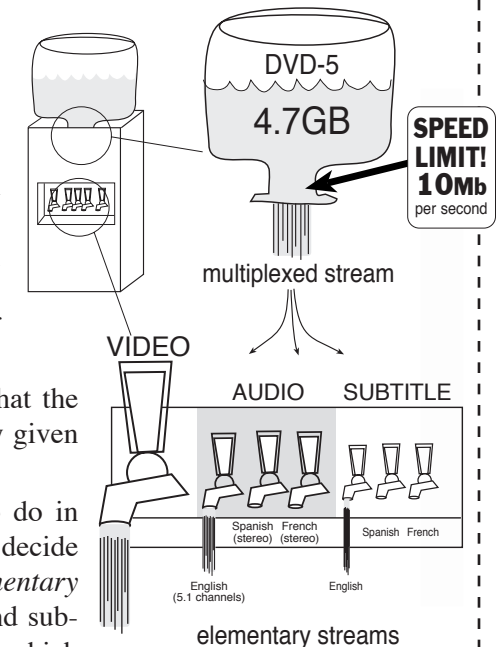
= a predominantly creative, aesthetic, "offline" activity = a predominantly technical, "online" activity

"BIT BUDGETING" SIMPLIFIED

Bit budgeting can be a slightly tricky concept because there are not one, but *two* different limits to keep in mind: the total capacity of the disc you've chosen (e.g., DVD-5, DVD-10), as well as the maximum speed the drive can "stream" that data off the disc.

Imagine a special water cooler that holds data instead of water. We can let the data flow out faster, which means a better quality picture, but there'll be less time before the supply runs out. Conversely, we can ration out the data slower and get a poorer quality picture, but it will flow for a longer period of time. (This is much like the usual quantity vs quality tradeoff on an NLE.)

But there's another catch: the bottleneck limits us to a maximum data flow of 10 million bits per second (10Mbps). That's the total "speed limit" at which a DVD player (or "1x" DVD-ROM) can read data from a disc. And this doesn't just include video—this one big *multiplexed* stream of data includes *all* the simultaneous video, audio and subtitle tracks that the viewer gets to choose from at any given moment.



So, one of the first things to do in designing a particular DVD is decide how many of those individual *elementary* streams of data (picture, sound and sub-picture tracks) the viewer has from which to choose. She can switch between some of them or turn them off (kind of like TV channels). But the drive still has to read **all** of that data off the disc as it spins around in the drive (the one big "groove" on the DVD is that one all-encompassing multiplexed stream).

Thus, the challenge to bit budgeting is two-fold: (1) make sure all the simultaneous data streams don't exceed the DVD speed limit; and (2) make sure you don't run out of total disc capacity by the time the show is over.