# Shooting for DVD, Blu-ray, and Web

Although DVD sales have dropped considerably since 2005, the gross revenue from theatrical and nontheatrical disc sales is still substantial at almost $20 billion[1] annually. Given this reality in the next few years, chances are the successful shooter will owe at least a part of his livelihood to the 5-in. disc. Whether we shoot features, music videos, or high-school plays, DVD is still keeping many of us solvent these days; and that will likely continue to be the case, even as many of us dip our toes and perhaps our entire legs into Blu-ray and Web video production.

Because so much craft and discipline go into creating a commercial DVD, it makes sense as shooters-storytellers that we adjust our thinking to accommodate the format's particular requirements. It matters less that our images look great out of the camera or NLE. What really matters is how our images look at the end of the DVD rainbow; which is, after all, how the public will most likely view and judge our work.

The shooter can use various strategies to improve the quality of his DVD storytelling. Shooting 24p certainly makes sense because every DVD player is a native 24p playback device (Fig. Web.1). Since 1996, movie studios originating on 24 fps film have logically encoded their movies to DVD at 24 fps (Fig. Web.2). Relying on the player to perform the conversion to 29.97-fps NTSC (or 25-fps PAL), the DVD shooter can capture, edit, and encode at 24 fps (actually 23.976 fps) and thereby reduce the file size of his finished program by 20%. This is a significant savings, given the trend these days to jam everything and the kitchen sink on the 5-inch plastic disc.

Shooting 24p also can enhance resolution and detail by eliminating the 1/60-s temporal artifacts that can occur between interlaced frames. The suppression of *aliasing* is a major reason for the improved look of DVD programs captured, finished, and encoded at 24p.[2]

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[1] Source: *Daily Variety,* January 6, 2009.

[2] See Chapter 3 for more insight into the relative advantages of progressive versus interlaced recording.

(a)



**FIGURE WEB.1**
Outputting to NTSC, the DVD player performs the conversion of 24p encoded files to 29.97 fps. You might consider the complexity of this task when investing in your next DVD player. The $13 model at your local Rite-Aid may not be the wisest choice.

(b)
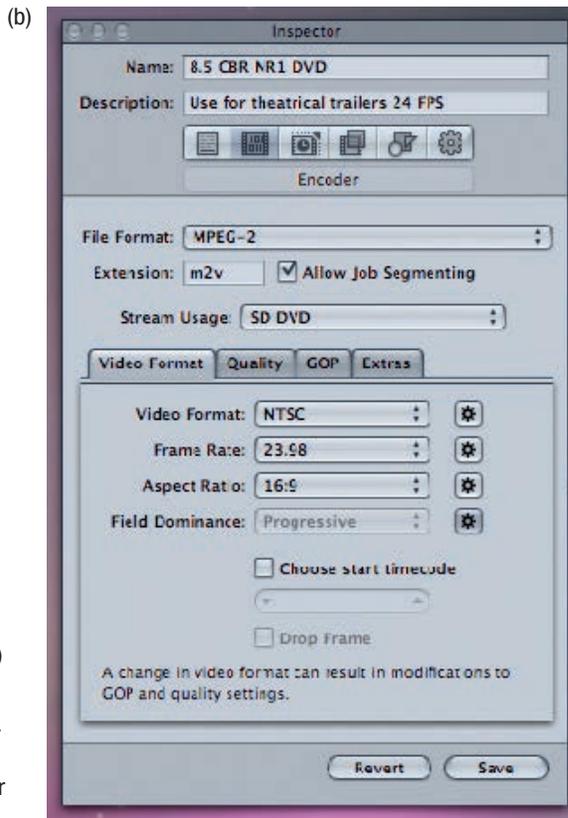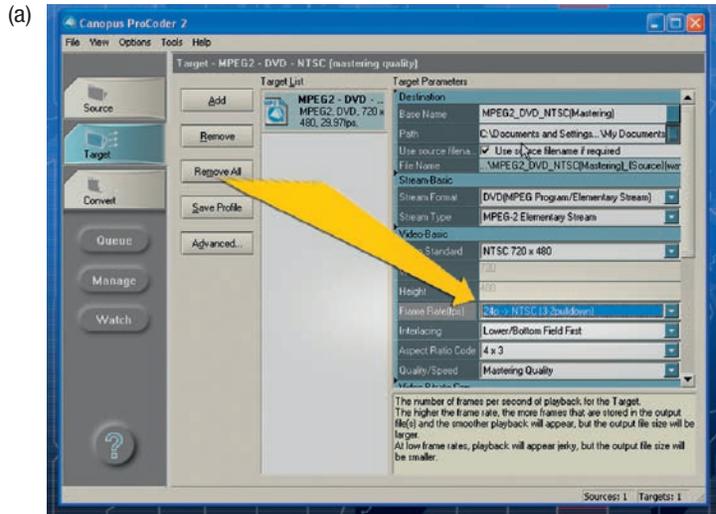


**FIGURE WEB.2**
Transcoders[3] like the Canopus ProCoder (a) and Apple Compressor (b) correctly tag 24p-encoded files for interlaced playback at 29.97-fps NTSC (or 25-fps PAL).

[3]A *transcoder* converts one type of digital file to another using software; a hardware *encoder* converts to MPEG or other format from analog or digital videotape. In practice, encoder is used generically to describe either tool, hardware- or software-based.

DVD's high compression underlies the need to monitor the camera's detail level, as this more than any other setting can impact the look of DVD images. With camera detail set too high, the hard edge around objects is exacerbated and appears far more objectionable after compression. Raising or lowering camera detail affects the thickness and appearance of this edge, and the potential for blocking artifacts that may arise during playback of the DVD program.

In Chapter 3, we cited the advantages of HD over SD origination; the additional fineness of the higher resolution image being infused into DVD's standard-definition picture structure. The effect is similar to shooting 35-mm film for release on lowly 240-line VHS. The 35-mm original looks a *lot* better on VHS than originating on VHS in the first place.

## DVD MEANS MORE SHOOTING GIGS

As a shooter turned DVD-storyteller, perhaps this is your real agenda. Being proficient in the ways of DVD means interfacing more productively with the directors and other folks who make shooting gigs happen.

Many of these increased opportunities are attributable to the disc's extra value content. According to a survey that appeared in the Los Angeles *Daily News* several years ago, deleted scenes are the single most popular "extra value" feature on a DVD.[4] This contrasts with less-demanded features like storyboards, trailers, and Web interactivity. The latter option has proven particularly unpopular in DVDs, as it inconveniently requires the insertion of the disc into a properly configured computer.



**FIGURE WEB.3**
DVD has fostered a strong demand for extra value content, which presents bountiful opportunities for shooters. This rear panel is from the *Lost in Space Platinum Edition*.



**FIGURE WEB.4**
Popular DVD extras for feature films continue to be a source of work for the shooter-storyteller.

[4]Los Angeles *Daily News*, Business Section, July 17, 2002.

The inclusion of deleted footage on a disc presents a quandary for the shooter. For one thing, everything we shoot, no matter how poorly framed or executed, is potential fodder. Some of our worst takes, indeed our *worst* work, may wind up as extra value on the DVD seen by millions. As shooters, we are usually powerless to stop it, as producers seem ever more eager to feed the public's appetite for outtakes and screw-ups of every kind.

## FINDING Y OUR STOR YTELLING NICHE

In the DVD marketplace, opportunities still exist to earn a good living, and not just in the entertainment realm. In the legal world, shooters capture and encode to DVD an entire day's worth of depositions and testimony. In the medical field, we provide video support and consolidate doctor and patient records into a searchable DVD archive. In real estate, games, public health, and employee training DVD continues to dominate the landscape, reflecting the ongoing demand for storytellers who recognize the potential of the digital versatile disc.



**FIGURE WEB.5**
Car and motorcycle DVDs are always big sellers.



**FIGURE WEB.6**
A kissing DVD might have a lot of appeal to romantics.
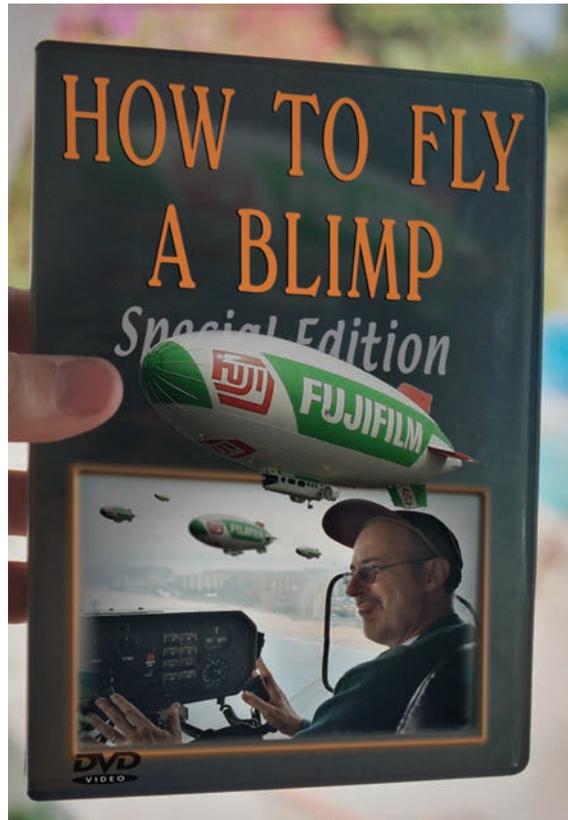


**FIGURE WEB.7**
How to Fly a Blimp? Somebody out there will want to buy this DVD!

Nowadays, a modest camera and basic editing software are well within the means of nearly everyone. What really matters now is who owns the *content*, or more precisely, who owns the content that anyone wants to see. For the shooter-storyteller with access to compelling material, DVD can be a gift from the gods.

So who are these lucky content owners? It's someone with the ability to tell an engaging story, and that could mean *anyone*.

Why? Because there's bound to be an audience for a subject, no matter how specialized or esoteric. If you're a 1960's VW fanatic like me, you could produce a DVD on this heady subject and almost certainly realize a healthy return. Given the low or no cost of shooting and editing a video, you don't have to sell 1,00,000 units to break even. You don't even have to sell 10,000. A mere 500 DVDs sold at $20 apiece will still yield a not-so-shabby $10,000 – and what husband or wife *wouldn't* invest $20 in a DVD at Christmas time that so precisely targets a spouse's passion?

## EYE ON THE D VD IMA GE

The shooter is, of course, foremost concerned with the integrity of his images; and in that way, DVD has profoundly transformed how others see and judge our work. Whether we like it or not, our meticulously lit, doted-over images will be compressed on the order of 40:1 – and that compression must be done right and with due respect.

In the ideal world, the shooter-storyteller has ultimate control over the DVD encoding. All other factors impacting the shooter's craft – lens performance, camera setup, and filter nuances – pale in comparison to the inescapable reality that poor quality compression for the Web, satellite, or DVD can make any show we produce, no matter how well crafted, look like a Seurat painting.
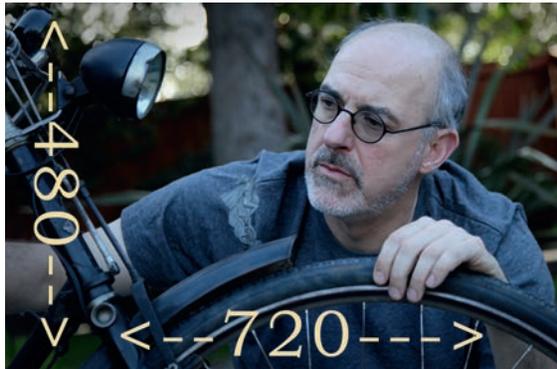


**FIGURE WEB.8**
Standard definition DVD requires MPEG-2 long GOP-encoded assets at 720 × 480 NTSC; 720 × 576 PAL.



**FIGURE WEB.9**
DVD players also support MPEG-1 352 × 240 (VHS quality) displaying these programs full-screen.
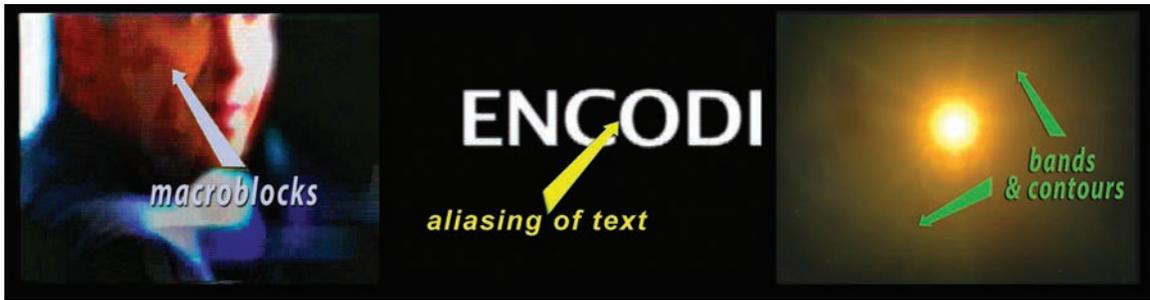
**FIGURE WEB.10**
Banding, macroblocking, and aliasing artifacts. The DVD storyteller ignores major compression defects at his own peril!



**FIGURE WEB.11**
Most people agree: compression artifacts is not fine art! This is Seurat's *A Sunday Afternoon on the Island of La Grande Jatte*, painted in 1884.

Common artifacts like *macroblocking*, *vertical aliasing*, and *contour banding* (Fig. Web.10) can be highly disconcerting to viewers. Your job as a new breed shooter-storyteller is to minimize potentially alienating defects when encoding to DVD.

## KNOW YOUR CODEC,  KNOW YOUR ENCODER

DVD still holds significant promise for the enterprising shooter, but there is also peril in them thar bits. Like HDV, AVCHD, and XDCAM, MPEG-2 for DVD is a DCT-based[5] codec that seeks to identify redundant fields, pixels, and blocks inside a frame and across a series of frames called a *GOP*. If you look closely at successive movie frames, you'd notice little difference from one frame to the next. The engineers of the Moving Picture Experts Group (MPEG) recognized that any variation in color or motion over a small group of frames is usually slight.

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[5]Discrete Cosine Transform (DCT) provides a means of sorting data to make it easier to discard picture elements not particularly visible or relevant. DCT is applied to $8 \times 8$ pixel blocks in standard definition.
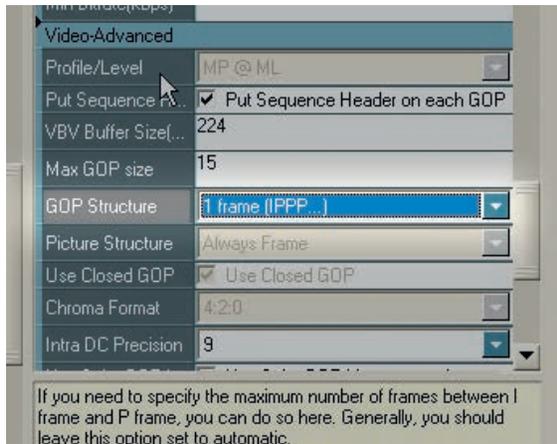
**FIGURE WEB.12**
GOP size and structure can have a subtle but significant impact on a story's visual tone. Although IBBP construction produces the most natural representation of motion and color, other GOP structures may be useful to impart a slightly surreal look to your story.

## ENCODERS HAVE PERSONALITIES

The DVD storyteller understands that different encoders may favor one compression parameter over another. One encoder may work well with high-action sports such as rodeos but perform less robustly when confronted with a Christmas parade at night with complex colors and costumes. To the adept
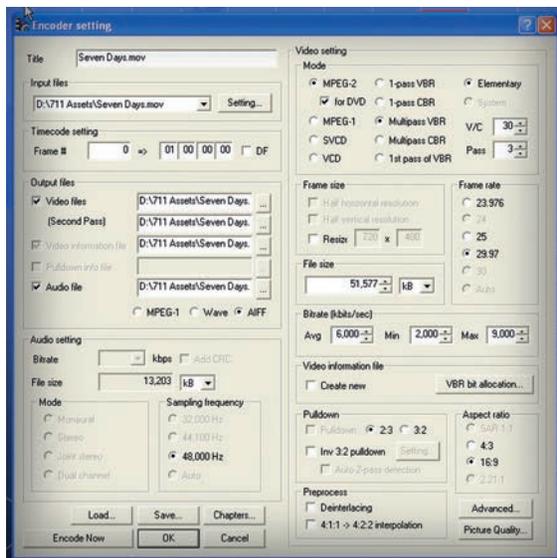


**FIGURE WEB.13**
Its excellent sharpness and contrast make the Cinema Craft CCE-SP encoder well suited for feature film production. Engineers working within narrow constraints must juggle the demands of good color and contrast with adequate motion estimation.



**FIGURE WEB.14**
In recent years, Apple Compressor has improved significantly with better contrast and less image softening.

shooter, the brave new world of HD, MPEG-2, H.264, and VC-1[6] means understanding a range of encoders based on their individual strengths and weaknesses. No single tool can be expected to do it all, even hardware-based encoders costing tens of thousands of dollars.



**FIGURE WEB.15**
The shooter should be aware of scenes that could pose a challenge to the MPEG-2 encoder. Fast moving objects like this London taxi racing through frame can produce visible artifacts on screen.



**FIGURE WEB.16**
Expanses of water with gently shifting waves are notoriously difficult to compress. Be sure to scrutinize such potential problem areas during your quality review.

## SCENES THA T SPELL TR OUBLE

In the land of DVD and MPEG-2, high bitrates alleviate most objectionable artifacts. The more bits used to describe a scene, the more likely the scene will be reproduced free of obvious defects. Practically speaking, a high bitrate of 7 or 8 Mbps obviates the need for a more sophisticated encoder, as modern encoders invariably perform well at such levels. Of course, high bitrates also reduce the available run-time on a DVD, which could be problematic if a total program exceeds 45 min or so.

The shooter should also be aware of scenes that present a significant challenge for MPEG-2 encoders. Fades and dissolves to and from high-contrast static frames can be especially challenging, and therefore require extra scrutiny during the QC process. Scenes containing wafting smoke, expanses of water, rustling leaves, and falling snow are also inherently tricky (Fig. Web.16). The smart shooter recognizes these potential troublemakers and stays on top of them from image capture through postproduction and DVD encoding.

## THE NOISE REDUCTION IMPERATIVE

The shooter should take care to reduce noise in the original recording as much as feasible. Single-pixel noise is Public Enemy No. 1, as the DVD encoder may find it impossible to discern the noise you don't want from the image detail you presumably do. The de facto use of a *tightening* filter like the Tiffen 1/8 Black Pro-Mist may

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[6]MPEG-4 is a nonproprietary standard. H.264 is Apple's variant of MPEG-4 that currently dominates and is widely seen as "industry practice." Video Coder (VC-1) is Microsoft's own variant of MPEG-4 and is less commonly used. Isn't life exciting enough? Do we really need all this intrigue?

**FIGURE WEB.17**
Large monochromatic areas like the blue sky in this scene may exhibit significant noise in the encoded file. Turning down the detail level in camera or employing a weak diffusion filter will help.



**FIGURE WEB.18**
Software tools like the Innobits Video Purifier can substantially reduce noise prior to encoding to DVD.
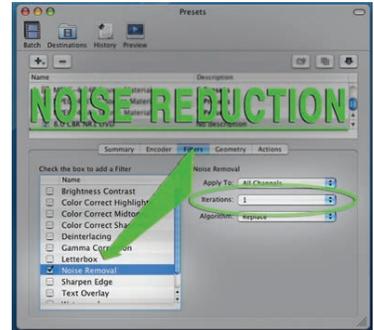


**FIGURE WEB.19**
When using Apple Compressor, mild noise reduction (Iteration = 1) is usually advisable to help performance. The application of noise reduction in any form significantly extends processing time.

help tame unsupported shadows and large monochromatic areas of the frame (Fig. Web.17), and significantly improve the look of the finished program on DVD.

Besides turning down Master Detail and applying camera diffusion, some noise reduction may also be applied in post. The *Video Purifier* (Fig. Web.18) from Innobits AB helps cut noise after a movie is rendered out of the NLE. Most DVD encoders have some kind of built-in noise reduction capability. Although NR is usually recommended prior to MPEG-2 compression, due care should be exercised to avoid excessive loss of image detail, especially in the shadows.

## KNOW YOUR ENCODING MODE

Because cleaner, crisper images are usually our goal, it would seem to make sense to encode with as high a bitrate as possible. The notion is constrained, however, by DVD's 9.8 Mbps maximum throughput rate (inclusive of video, audio, and subpictures[7]) and the capacity of the disc.

In satellite TV, the MPEG-2 streams must move through a satellite's finite "pipe." To simultaneously move as many streams as possible, many individual "conveyor belts" operate at a constant speed with each "package" being approximately of equal size, as packages of varying girths could occasionally collide and clog the pipe. Thus moving identical-size packages at a constant speed (CBR) is the most efficient use of this type of delivery system.

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[7]Subpictures are the menu overlays and subtitles that comprise DVD's third data stream.
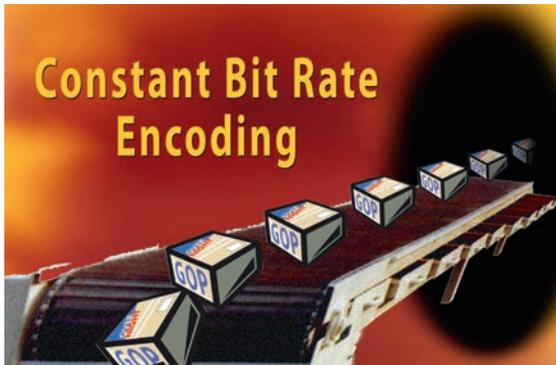
**FIGURE WEB.20**

At a constant bitrate (CBR), exploding battleships and talking heads receive the same allocation of bits regardless of the scene's complexity. Although CBR is required for multiangle titles, variable bitrate (VBR) encoding produces better results for long-form DVD projects of total running time more than 45 min. For brief demo reels, go CBR (Apple calls it "One Pass") at 8.5 Mbps and be sure to encode your audio to Dolby 2.0, or you won't be able to burn your DVD!
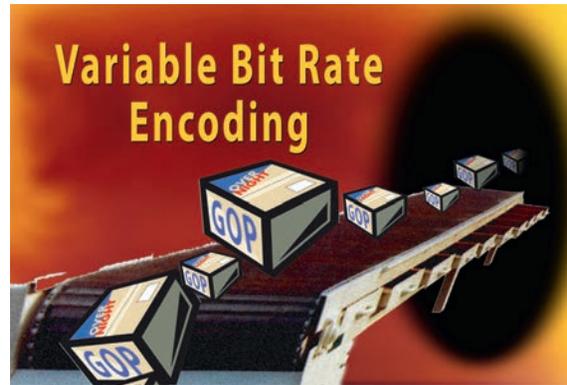


**FIGURE WEB.21**

VBR, represented by different-size packages on the conveyor, is more efficient for longer programs since bits scavenged from static scenes like a reporter's standup can be reassigned to action scenes like a barroom brawl. Such adjustments in the bitstream take place at the GOP level in as few as four frames in NTSC!

**FIGURE WEB.22**

Although VBR allocates bits on an "as needed" basis, the average target rate is maintained so as not to exceed the maximum file size determined by the project bit budget. Most Hollywood movies are encoded VBR at 4.5–5.5 Mbps. Encoding MPEG-2 CBR at under 3 Mbps will seldom produce acceptable results regardless of encoder.
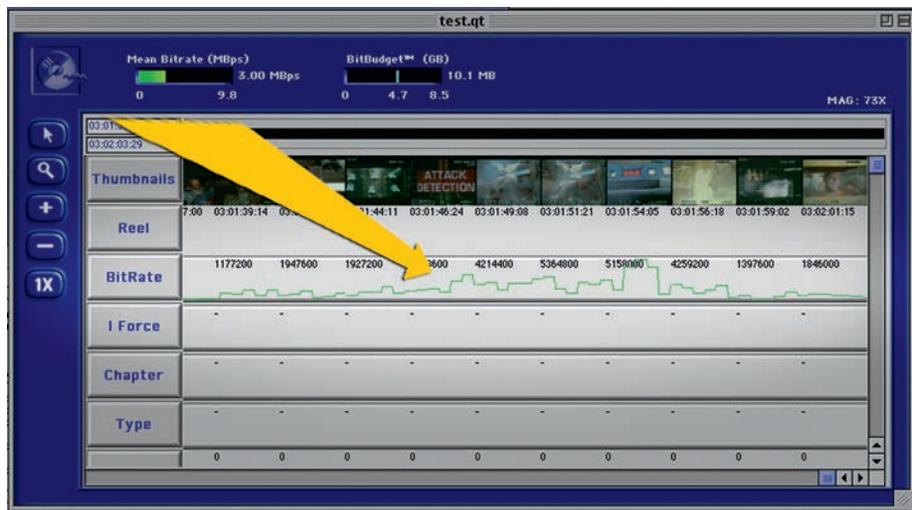


## MEET THE VILLAIN OF OUR STOR Y

The $13 DVD player is more than a nuisance. It's a public scourge, as unsuspecting folks attracted to the low price snap up the poorly performing machines. Because impaired playback can reflect negatively on us as craftsmen, it is in our interest to know the enemy and know him well.

The hallmark of an *el cheapo* unit is out-of-sync playback, which the public invariably attributes to a defective disc. If a disc is authored and encoded to the DVD specification and the player is designed and manufactured to the same standard, all should be fine in the Promised Land. But when manufacturers cut corners, as they are inclined to do, we DVDers start to shake in our jewel cases. After all, there's only so much we can do to ensure our images are properly reproduced on shoddily constructed substandard players.



**FIGURE WEB.23**
$13 DVD player. Beware the evil among us! The cheap DVD player can sink your career lest you take some common sense precautions.

## THE DVD-R (+R) MORASS

According to the standard, DVD-Video discs must be replicated in a manufacturing plant where millions of microscopic pits are pressed into a thin plastic substrate. DVD-R (+R) media that are burned do not have physical impressions but *simulated* pit shadows created by tiny drops of dye that change the color in response to the burner's laser. Some players, even the most recent models, don't buy this phony pit ruse and may react erratically. The low reflectivity of the simulated pits leads to tracking errors and is a major contributor to the incompatibility of DVD (and Blu-ray) recordable media.

The relative compatibility of DVD-R (+R) can be the subject of a long discussion. Bear in mind that player "compatibility" is seldom an all-or-nothing thing. A disc will often load properly and play for a while and then act screwy. This may take the form of weird navigation, out-of-sync audio, or refusal to play a disc at all. Erratic playback is most likely to occur later in a DVD program, as the player's laser tracks outward from the center of the disc, encountering greater *wobble* and warping of the disc that can produce playback anomalies.



**FIGURE WEB.24**
The DVD's data stream is read in a continuous spiral from the center of the disc. Inferior DVD-R (+R) media may be slightly warped, leading to the tracking and compatibility issues on some players.



**FIGURE WEB.25**
Only replicated discs (prepared in a manufacturing plant) can legally bear this logo. Pressed DVD-Video discs exhibit few playback anomalies.

**FIGURE WEB.26**
Satisfactory playback of DVD-R (+R) should never be assumed in an unknown player. This section from a professional testing service report lists the player models tested for compatibility.

For critical presentations, a player should be tested to assess DVD-R (+R) compatibility. You can hire a professional company to do this for you – there are a number of them around – or you can simply venture into your local electronics megastore (if you can find one still in business) and do your own impromptu evaluation with the store's permission, of course.

## DVD-R VERSUS DVD+R: WHAT'S THE DIFFERENCE?

Both formats of 4.7 GB capacity are comparable in design and compatibility. The major difference is DVD+R allows recording in sessions; DVD-R does not. Thus, DVD-R must be finalized after a single session, while DVD+R media can record multiple sessions and so may be more suitable for home use. In any case, the +R disc must ultimately be "closed" before it can be played back on a set-top player.

### ABOUT DVD + R DL

This type of disc with a nominal capacity of 8.54 GB provides two recordable layers of data on a single-sided DVD. Although DVD + R DL media is not sufficiently compatible with players for general distribution, the dual-layer disc offers the only practical way to proof DVD-9 titles – provided, of course, a player can be found to reliably play it.

## IMPROVING YOUR CHANCES

With respect to standard definition DVD players, here are a few tips to help your DVD-R (or DVD+R) discs play more reliably:

- Encode video no higher than 7.5 Mbps maximum bitrate: due to the low reflectivity of recordable media, high bitrates over 7.5 Mbps may impede some players' ability to satisfactorily decode multiplexed audio and video streams in realtime.

■ Use Dolby Digital AC-3: to facilitate playback of video at moderate to high bitrates, the use of compressed audio (i.e., Dolby AC-3) is imperative to avoid player stutter or freezes. Although AC-3 compression entails some compromise in audio quality, the smaller file size and concomitant gain in player compatibility are usually worth it.

■ Avoid burning to the outside edge of a disc (Fig. Web.27): compatibility problems increase as the player's laser tracks outward. Maintaining 5–10% of free space on a recordable DVD may reduce read-errors in the vulnerable edge region, especially when using low-cost media.

■ Use high-quality media: cheap media is responsible for more incompatibility problems than any other factor. Spending a bit more per disc is worth it if your clients are able to view your work with fewer hassles and hiccups.

■ Consider replication instead of duplication: if you require more than 50 discs of a title, it may make sense to replicate your DVD. The price for a minimum 1,000-unit run is below $.50 per disc, in many instances with a simple label and storage box. Shorter runs don't usually offer much savings owing to the inherent expense of preparing a glass master or *stamper*.

## BLU-RAY ANY ONE?

Who can forget the format wars of earlier this decade that left wannabe HD-DVD in the digital dust? HD-DVD may have offered greater flexibility, more accessible authoring tools, and better compatibility with standard DVD, but story and content is king, and Blu-ray with the preponderance of Hollywood studios behind it ultimately prevailed.

Since the cessation of hostilities in 2008 and the HD-DVD camp tossing in its jewel box, Blu-ray's fortunes have been relatively lackluster. Despite nearly one billion dollars in U.S. sales in 2009 and an expected 3–5% annual growth, the format remains (as Apple's Steve Jobs so famously remarked) "a bagful of hurt."

As of mid-2009, Apple still doesn't support Blu-ray in any meaningful way, and its DVD Studio Pro authoring tool has yet to be updated for the preparation of Blu-ray discs. For its part, Adobe continues to develop its Encore[8] application, a reasonably competent and inexpensive DVD/BD authoring tool for the Macintosh and PC.



**FIGURE WEB.27**
Compatibility on some players is enhanced by not utilizing the full capacity of the disc. Note that a minimum recorded area is required. If your program is short, your burning application will lay down the required minimum as zeroed bits "lead out."
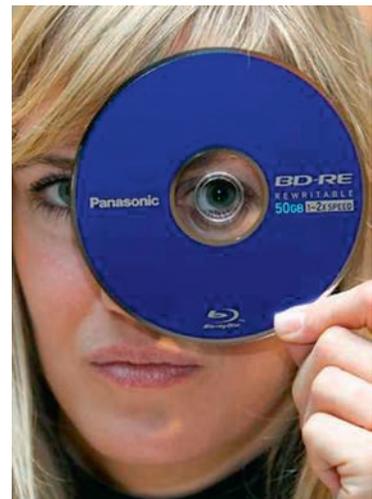


**FIGURE WEB.28**
Keep an eye on technology! Some folks may dispute the need for an HD disc format since 1080p uprezzed output from standard definition DVD can look nearly as good as actual Blu-ray-sourced footage.

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[8]Adobe Encore for Mac and PC is included in the company's Creative Suite of applications.

## WHAT A MESS

For most video storytellers, the distribution of replicated Blu-ray discs was and continues to be largely impractical. The major reason is the onerous and mandatory licensing scheme that, until recently, required thousands of dollars in fees per title. This fee structure put in place for Hollywood's largest studios has effectively placed BD replication out of reach for producers of corporate, business, and nontheatrical titles requiring less than 5,000 copies.

The Advanced Access Content System (AACS) was intended to thwart pirate replication of Blu-ray titles by preventing the playback of homemade "burned" discs without proper authentication.[9] It was a crude stick, but it worked – too well, to the detriment of the format and those who would have liked to adopt it.

In June 2009, a reduced fee structure was introduced to encourage producers wishing to replicate Blu-ray titles in small quantities. The one-time $3,000 fee to become a licensed *Blu-ray Content Provider* was replaced by a $500 annual payment. The once $1,300 per *Title Key* was superseded by a $500 charge per key per glass master. The 4–5 cent per disc AACS use fee still applies, however, and so the total charges for BD replication are still substantial. It is certainly not for the casual user wishing to stamp out 50 Blu-ray discs of a high-school play!

Keep in mind, of course, that Blu-ray titles need not be replicated; they can be *duplicated* in small batches and burned as "one-offs" to BD-R or DVD-R (+R), in which case the AACS fees are not applicable.

## BLU-RAY IN SMALL DOSES

Despite the AACS intrigue and associated fees, there is a growing niche for Blu-ray titles for festivals, video walls, and other applications for which the replication of a large number of discs is not required. I use BD-R, for example, to distribute my shooter's demo reel to select producers, the quality of Blu-ray playback being critically better for demonstration purposes than standard definition DVD.

As has unfortunately been the case for DVD players, Blu-ray player compatibility with recordable media can also be the source of anguish. Burning short-duration 20-minute Blu-ray Movie (BDMV) volumes to DVD-R media may be economically attractive; but some players, notably from Panasonic, reject such discs. Cheaper machines manufactured in China, seem to be much more forgiving, however, playing back BDMV or AVCHD volumes from DVD-R (or BD-R) without limitation.

AVCHD shooters will find burning high definition to DVD-R a straightforward process, as direct playback via SD memory or DVD-R (+R) is supported in most Blu-ray players. Shooters, however, wishing to take advantage of BD's advanced

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[9] The AACS was set up in 2005 and is administered by a consortium of companies including Disney, Intel, Microsoft, Panasonic, Warner Bros. IBM, Toshiba, and Sony.
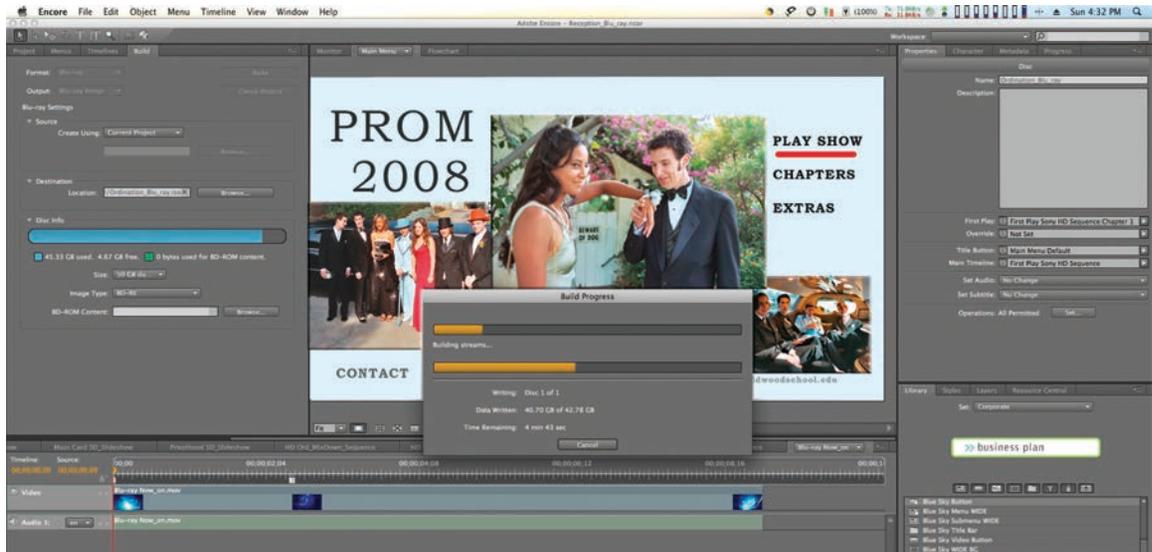
**FIGURE WEB.29**
Blu-ray titles for demo reels or special events are a growing market for some HD storytellers. These projects not intended for replication can be authored in Adobe Encore and output to recordable media on a PC or Mac.

codecs, such as high-level H.264 and VC-1, will have to output a BDMV (Movie) volume. This volume burned to BD-R is compatible with most BD players, albeit at a much higher price per disc than inexpensive DVD-R (+R) media.

## WEB VIDEO AND THE FUTURE OF VIEWING

Video shooters are of course looking to the Web, and therein, no doubt, lie immense opportunities, if we can only figure out how to make a living from the damn thing. In theory, the potential of hundreds of millions of eyeballs world-wide holds the promise of sizable financial returns for video storytellers; and indeed, there are indications that there is revenue to be had. Advertisers love Web videos because they are cheap to produce, they can track the number and quality of eyeballs they are reaching, there is no conventional "ad buy," and a campaign on the Web can last indefinitely. I'm finding Web campaigns from 2004 still up and running on clients' Web sites. The Web compared to other venues like print, for example, seems like a tremendous value for advertisers.

The challenge for shooters is creating and marketing content – music, feature films, short subjects, training videos of all sorts – and somehow deriving an income from a medium that, at the moment at least, is essentially free.

Will the only viable model be advertiser-based or will pay-per-view prove a real-istic option as well? Will a subscription model ultimately prevail or will another more workable model emerge? It's difficult to say as we begin this uncertain

journey together: every shooter must examine his or her own comparative advantage to forge a distinctive niche.

And what might the video stories and Web videos of the future look and feel like? For one thing, viewers will have the ability to stop and go back into a story to investigate a plot twist or pose questions of other viewers, contact a favorite star, or review previous scenes or episodes in which that star appeared. Future Web videos will also allow viewers to weave in bits of outtakes or alternative scenes to create to their own edited story versions.

Storytelling on the Web will be less linear, with the raw elements of story provided at a basic level. One implementation might be akin to a DVD behind-the-scenes featurette. We'll see many of the same things we see currently in extra-value content like director's notes, storyboard sketches, and commentary, but the elements will be more freely available and in a richer more interactive way.

The viewing of future Web videos will require a fast media server – but not that fast. Given HD streaming only really needs 8 Mbps to achieve 99% of Blu-ray's visual quality, we can envision a time when hundreds of millions of viewers worldwide will have access to our HD stories.

Blu-ray will have its place; but the Internet offers greater flexibility and even higher definition beyond 1080p for industrial, scientific, and movie event applications. The business of Web video is moving fast. Whatever technology, company or content, pirated or legalized, it's all happening. Now.