## How to do a matchback while retaining sync and sanity
by Su Friedrich

# Finishing on Film



*The Odds of Recovery* **mixes both 16mm film and video formats, which all had to be transferred to 16mm.**

Last year, I finished post-production on *The Odds of Recovery*, a 65-minute film that includes both Hi-8 video and 16mm source material, using Final Cut Pro (FCP). The biggest challenge I faced was learning how to do a matchback—in other words, how to get the digitally edited version of the film correctly translated into a matching 16mm version, which is cut from the original 16mm negative. I couldn't understand any of the articles written about the process, so the experience was a painful case of "learn as you go." In the end, the struggle paid off because the film is cut exactly as I meant it to be and has no sync problems. Even though *The Odds of Recovery* mixes formats, the following steps for doing a successful matchback apply whether your piece is 100 percent film or in mixed format because, in the end, all video original has to be replaced by 16mm film. Moreover, my advice holds true whether you use FCP, Avid, Media 100, or any other digital editing software.

On my project, I transferred from the 16mm negative to Beta to mini-DV. (These days, one can more easily find transfer houses that go directly to mini-DV or DVCam.) I couldn't afford to do a professional transfer from Beta to mini-DV, so my homemade transfers "lost" the Beta time code, which meant that a computer-generated edit decision list (EDL) wouldn't have a correct reference to the original negative. I created my own EDL by logging all the clips in the final edit from the computer. I also decided in the end to workprint all my negative rolls and cut a workprint of the final edit as a guide for the negative cutter. This isn't necessary, but I wanted to be sure that my shots were working and that sync was correct. I'm assuming that most of you will choose to work with an EDL generated through FCP (perhaps with the help of FilmLogic) or one of the other editing software programs. In that case, you must be sure that your DV transfers have the correct time code reference (i.e., that they agree with what's on your Beta, if you went first to Beta). What follows addresses the problems inherent in working with an EDL, but the same issues prevail if you work, as I did, with "unattached" time code.

If you detest manual labor or are willing to have your edits changed by the EDL, you can ignore this article. However, if you don't want the EDL to alter your cuts, or if you can't afford to do a remix after your first answer print to fix sync problems, then read on. The world of video doesn't agree with the world of film, and eight months of post-production hell taught me that a Herculean effort is required to assure a foolproof matchback. Two essential things must be grasped in order to accomplish this. One concerns how your footage is coded, i.e., what the codes mean when you transfer film to tape; the other is how matchback is controlled by the conversion of frame rates, or running time, from film to video. But first...

### Getting Started: Some Things Before the Essential Things

When you transfer your film to tape in preparation for editing on the computer, be sure the transfer is done at 29.97 *non-drop* frames. (Note that we refer to video as having a rate of 30 frames per second even though transfers are actually done at this "correcting" rate.) Transfer houses should know to do it that way, but write a letter stipulating it, so you're protected if they do it wrong. You also must have both the video time code and the film's key code (formerly called "edge code") visible on the screen. Ask that both codes be put on a black strip as low down as possible so they don't interfere with your image, but also be sure they're legible—it's very important that the codes are legible. For each reel, specify at which hour the time code should start—Reel One is Hour One (01:00:00:00), Reel Two is Hour Two (02:00:00:00), etc. Having all your reels/shots start at Hour One creates confusion in logging and editing, but, unless you're specific, the transfer technician might not change the hour for each reel.

A horrible problem can happen with your key code during the transfer process if you're shooting 100-foot rolls (and may also happen with spliced-together 400-foot rolls). In the early stages of post-production, I transferred several thousand feet of spliced-together 100-foot rolls to Beta. Two months prior to that transfer, I had made a workprint of the same material and then logged it because I thought I would be cutting on film. When I started logging the newly transferred video, I discovered that the key code from one roll was carrying over to the next. In other words, the first 100-foot roll had key code starting with KK75 and the second one was a KH64 roll, but for 10, 20, or more feet into the second roll, the code from the first roll continued and then "caught up" and started recording the correct code from the second roll. I freaked and called the technician. He said it was a common prob-

lem—the machines often can't pick up the new key code quickly enough. Having perfect splices between reels doesn't help—I did, and almost every roll had a lag. (You could avoid this problem by transferring each roll separately, but the process would be much more expensive and the lab would hate you—all those setups for short reels.)

What to do? Whether you've made a workprint or just transferred from the negative, go back to your rolls, record the head and tail key code of each roll, and compare them to your video. If you find a lag, it means that portion of your video does not have correct key code reference and your EDL will be incorrect. Be sure to note any clips with "lagging" code in your final edit and figure out manually what the key code should be so that the negative cutter can find the shots.

Let's assume you've transferred your film at the right frame rate, with visible key code and time code, and you're back in the edit studio. The question is when to begin thinking about the issues arising from a matchback—in other words, when do you start dealing with the Two Essential Things? I suggest you start when you're fairly certain about the order of shots, but before you've started any elaborate sound editing. Correcting clip lengths while you're still making lots of editing decisions will drive you crazy and correcting them during, or after, the sound edit means adjusting all the sound tracks connected to each clip, which can be unwieldy.

## Pull-down: The First Essential Thing

Your source film and video are the same but different, and that's because the film-to-tape transfer involves what's called a 3:2 pull-down. Simply put, pull-down "stretches" your film in order to adjust for the discrepancy in the frames-per-second rate for film (24 fps) and video (30 fps). Fortunately, the time code and key code that's laid on during transfer gives you crucial information about how your source film was pulled down.

When the lab sets up for the transfer, the technician makes a hole punch in your film on the "A-frame," which is the first frame that has readable key code (after head flare). On the A-frame, the transfer machine starts recording your film's key code, but at the same time it's "stretching" the film, which I'll explain shortly. On the same A-frame, the machine starts recording time code at 01:00:00:00, or at whatever hour you designate. After each frame of time code, the transfer machine appends the letters A, B, C, or D. This dual coding runs through the entire roll, adding *one frame of video time* per frame. As your film is

being "stretched" to mimic video running time, your *time code* reflects that change through those ending letters and your *key code* reflects it in the individual frame count.

Let's get concrete about this. The pull-down process *doubles every fourth frame* of your film. To make sense of this, open up your project, pull up a clip, and look at your *burnt-in* time code. After each frame of time code, you'll see one of those letters (A, B, C or D, alone or in combination with a number). In any given reel, the *one* letter that gets doubled stays constant. If the lab doubles the D-frame on that reel, the D-frame will always be the one doubled. All you have to understand is that the D-D combo of *two* frames of video represents *one* frame in 16mm. (See diagram "Visual Aid.")

Best case scenario? Starting with the first frame, the lab doubles the fourth frame and puts the numbers in a logical sequence, so you have A-B-C-D-D or A1-B1-C1-D1-D2. However, any one of the letters might be doubled and the numbers (if they use them) might be in any weird order. I had reels transferred at different houses and got different patterns. For example, one of my reels had doubled Ds and a crazy numbering system—A2, B2, C1, D1, D3. *However, despite the vagaries of each transfer house's system, the function is always the same.* When you're working, ignore the numbers—for your purposes, they have no significance. Just pay heed to the letters, because they let you know which film frames have been "stretched," or doubled.

The other way to know is through your key code, which shows the doubling in the "+" numbers after the code. For example, you're at frame KH75 2568 9638 + 07, which means you're 7 frames past the first frame of the new chunk of code. If that's a doubled frame, then the next frame will also show a +07 count, and the ones after that will show +08, +09, +10, then you're at a new doubled frame, so it's +11, +11, etc. In general, I found it easier to work from the time code than from the key code, but either one tells you what you need to know.

You must heed the doubled frames when preparing for matchback, which is to say that a clip can't start on the second frame of a doubled frame. But this works in conjunction with the Second Essential Thing, so I'll go on to explain what that is, then show how they interrelate.

## Making the Cut: The Second Essential Thing

The doubling of some film frames allows the film to mimic video running time. However, in order to do a proper matchback, the video edit

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**Visual Aid**

The First Essential Thing: Understanding Pull-down
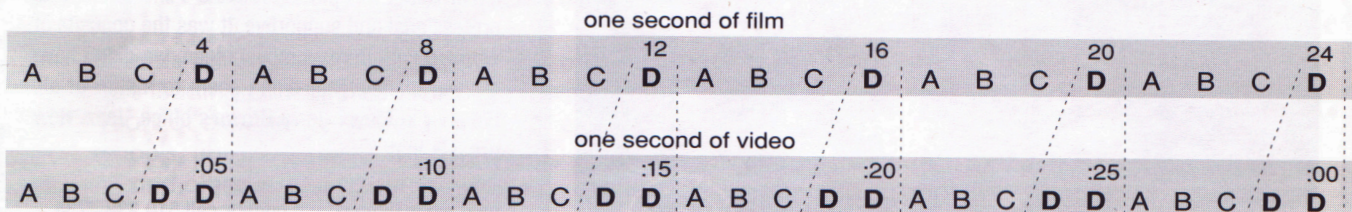


When the lab transfers your film, every 4th frame is doubled (frame #4 becomes 2 frames of video, each labeled D).
Your 4 frames of film has turned into 5 and your time code shows the doubled D-Ds.
(Your video time code for frames 4 and 5 would read 01:00:00:04 D and 01:00:00:05 D.)

must reflect what actually exists in your film negative. If it doesn't, your video cut will undoubtedly have clips that consist of partial film frames, either because of the D-D situation or because of the total clip length. In this state, the video cut cannot be replicated on film. This discrepancy will be corrected by the EDL and the negative cutter, thereby changing the head or tail frames of your clips and throwing off your sync.

When I had almost finished my fine cut, a friend loaned me a frame rate calculator (available from www.christys.net), which converts time code length for a video clip into its length in film frames. What did I discover? (I'll use actual numbers here.) The first clip I checked in FCP was 10:17 (10 seconds, 17 frames). The calculator showed that to be 253.6 frames of 16mm film. As you know, .6 of a frame cannot be cut. The next one was 17:09. In film, that was 415.2 frames, which is .8 of a frame short of a full frame.

Why is this? Look again at the diagram, which has a bar representing one second of footage in both film and video. The bar is divided into six units (4, 8, 12... and 5, 10, 15...) because the only number that divides into both frame rates (24 and 30) is six. As a result, in doing a matchback, your video clips can only have certain amounts in their frame count, i.e., they can only be of certain, fixed lengths.
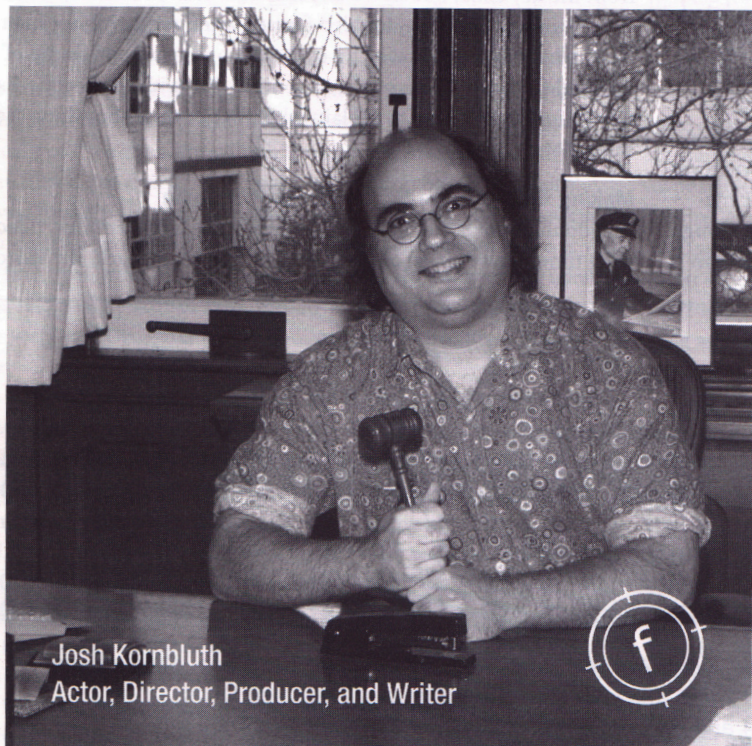
Let's consider the clip that's 10:17 in video, or 253.6 frames in 16mm. Your EDL will "adjust" this clip because the only lengths for a clip that yield whole film frames are ones in which the time-code frame length ends in a factor of 5 (0, 5, 10, 15, 20, or 25 frames). It doesn't matter how many minutes or seconds your clip is; only the number of frames matters. As you can see in the diagram, a 5-frame video clip is 4 whole frames in film, whereas a 3-frame video clip can't be translated into whole film frames—it's 2.4 frames. So, if you re-cut the 10:17 shot to 10:15, it will be 252 whole frames, and if you re-cut it to 10:20, it will be 256 frames. You cannot access those 3 frames of film between 4 and 8, 8 and 12, etc. You can see them in video, you can cut to them in the computer, but you can never actually have them in your film. Weird, huh?

### The Practical Application of the Two Essential Things

Let me first explain how an EDL works. The computer knows that your final program is, for example, exactly 00:18:25:05 in video length, or 26,524 frames in film. The computer also knows that you're working with film, which has been adjusted through pull-down and has doubled frames. So the computer runs through the program (think of it like a ripple edit) and adjusts each clip that's an irregular length (i.e., not divisible by five, like 17 frames) or starts on a half-frame (of D-D fame) because *the total program has to be the exact length in film that it is in video and it has to consist of whole frames.* This is how sync problems start, not to mention cuts happening on frames you didn't choose to cut on. I suspect you might not like how an EDL re-cuts your clips, so let's return to the world of manual labor, where you make your own decisions.

Back in the transfer, all those fourth single frames in your film were stretched to two frames in your video. You've been editing and

have made the perfect cut on the second of your D-D video frames (D2) and your clip is 17 frames long. Now, if you were to try and match that clip back to film, you would have to (try to) start the shot in the middle of a frame and end your cut using only .6 of a frame!

So, if you leave the clip on the second D frame, the EDL knows you can't cut there and it goes forward one frame (to A) or back one frame (to D1) in your video. But if you know you can't cut there, *you're* the one who makes the change before the EDL gets to it. And if you leave your clip at a "false length," like 17 frames, the EDL adds 3 frames, or subtracts 2, without any regard for how that affects the relationship with your previous or next shot (which the EDL will probably also re-cut). But if you know that your clips must be a "true length," with frame counts that are a factor of 5, *you're* the one who decides where to cut.

### Taking Control of the Situation

The bottom line is that, if you're a very picky editor and you're going to work with an EDL, you want to make sure you leave the computer no room to "correct" your edits. Similarly, if you're making your own log and/or workprint, you have to ensure that you're going to be cutting on whole film frames. So where does that leave you? Not exactly at square one, but you do have to check every clip length and re-cut them to show a video *frame* length that's a factor of five. Plus, when you're re-cutting all those shots, you have to be sure not to start on the second frame of a doubled frame. (Out of 750 cuts in my final edit, almost all had been

originally cut on a non-5 frame or the "second frame" and had to be corrected.) At least you don't have to worry about both ends—if you make sure your head frame time code shows a single letter or includes both of the doubled letters *and* make sure your total clip length shows a frame count that's a factor of 5, then your tail frame will always be okay. The sad fact is that things won't go together as beautifully now because you have to add or lose a few frames. If you had wanted it that way, you would have done it in the first place, right?

How unhappy are you? I finished the creative part of the editing in November 2001, and I didn't get through post until July 2002. I was at the final edit, with 14 audio tracks, before I understood how to do a correct matchback. I became so concerned about the possibility for error that I workprinted all the rest of my footage, used my handmade log sheet as a reference for key code and shot length, and cut a workprint for the negative cutter. Expensive? Yes. Exhausting? More so. But every shot came out right and the sync was perfect.

I hate to be the bearer of bad news, but if I can save you any of the confusion and excess labor I expended in getting my film out of the computer screen and onto the theater screen, I'm glad to be of service.
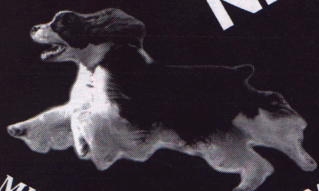
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*Su Friedrich's* The Odds of Recovery *premiered at the MadCat Women's International Film Festival in September 2002 and is still touring widely. Friedrich teaches film and video production at Princeton University. For more info on her films, visit www.sufriedrich.com.*