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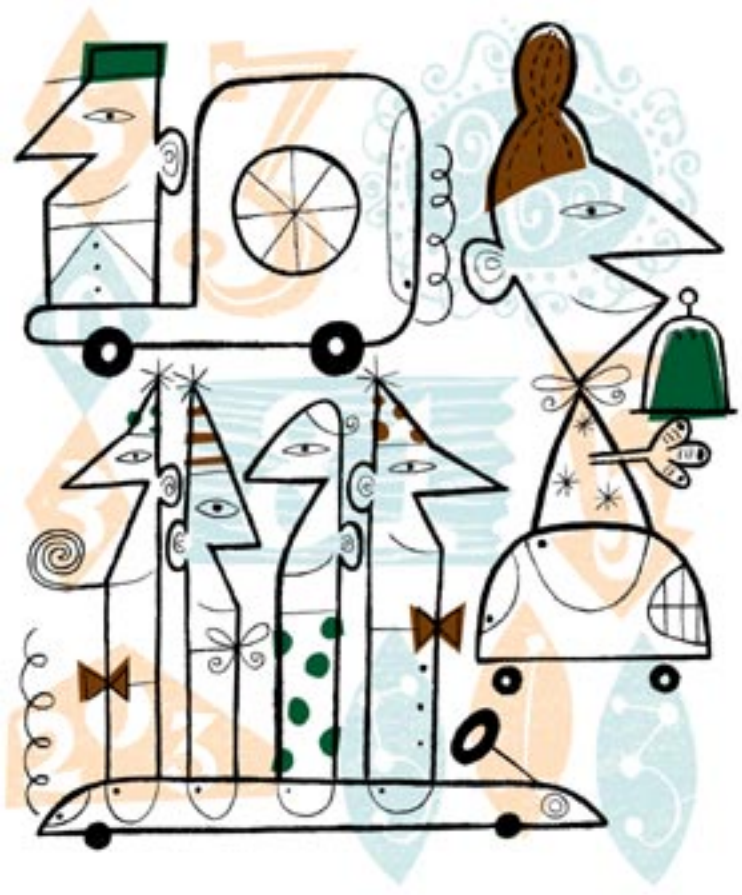
All in Good Timecode.

To edit video with precision, you need to understand the numbers



Imagine your neighborhood **without street addresses. It doesn't seem so bad when you envision Aunt Sophie driving around in circles, hopelessly lost, her infamous green-bean Jell-O salad melting away on the seat beside her.** But then you start to think about party guests, the mail, and a Saturday night pizza delivery, and you realize how vital your address is. The number above your door precisely identifies your house so that others can find it.

So it is with timecode and video. Timecode provides an accurate means of identifying a given frame of video within a large sequence. Timecode is the common, underlying language that lets you use video-editing equipment and software such as Adobe Premiere to specify, cut, and recombine a dizzying number of video frames into a coherent and meaningful story. Because timecode involves some arcane television history, a little math, and a few acronyms—all of which will be discussed here—it can be a little confusing, particularly for novice editors. But the precise measurement of time—knowing exactly where you are in your video—is essential for effectively editing your project in Premiere. What follows, then, are some basic concepts, rules, and guidelines for understanding timecode.

00:00:01:00 The basics

The Society of Motion Picture and Television Engineers (SMPTE), a recognized global leader in the development of standards for film and television, introduced what was to become the industry standard, SMPTE timecode, way back in 1967. SMPTE timecode, which Premiere uses, describes a given video frame in hours:minutes:seconds:frames. For example, the timecode 01:20:33:29 identifies a frame located one hour, 20 minutes, 33 seconds, and 29 frames into the source videotape. A video frame, of course, is a single image; a sequence of them played quickly creates the illusion of motion. In timecode, a video frame is also a measurement of time. A second of video is always divided into a certain number of frames, depending on broadcast or film formats (more about this later). For video that's played at 30 frames per second (fps), each frame is equivalent to 1/30th of a second.

How-to

Typically, a video camera stamps timecode on each frame as you're recording the video. The timecode is not actually visible on the frame, but is stored on a separate nonvisual band on the videotape. When you capture and digitize the video, the video-editing software reads the timecode and transfers the numbers to the digitized version.

00:00:02:00 The formats

As a simple counting scheme for video, timecode is fairly straightforward. The confusion arises when you need to pick a specific SMPTE format, or frame rate, for a given project. There are four different SMPTE timecode formats, each created for a particular need, and each with a different frame rate. The standard for film is 24 fps; 25 fps is Europe's broadcast standard, also known as PAL (for phase alternating line); 30 fps Drop-Frame is the broadcast standard for North America, as specified by the National Television Standards Committee (NTSC); and 30 fps Non Drop-Frame is the standard for editing audio in North America.

For film and broadcast in Europe, the timecode on each frame is what you would expect; in other words, a movie is played and counted at 24 or 25 frames per second. It's the North American broadcast formats, with their designations of drop frame, that are a little odd—frames are counted at 30 frames per second, but the video actually plays at 29.97 frames per second. To make such apparent silliness work, you need a little math. To understand why, you need to look at history.

00:00:03:00 The history

In the early days of television, programs such as *I Love Lucy* were shown in marvelous black and white. The signal for original, black-and-white television was broadcast at a true 30 fps—a rather uncomplicated time. But then technology advanced, and we could suddenly see Lucy's red hair and even, on those bad days, her dark brown roots. Color television was beginning to take hold. In 1953, the NTSC established a standard for broadcast of color signals that combined them with the existing monochrome signals (so all those black-and-white televisions in living rooms across America didn't become obsolete overnight). But, in combining signals, engineers found that certain frequencies interfered with each other, making broadcasts less than satisfactory (it's important to understand that a single frame of a television show is actually a signal, with a frequency). To correct the interference problem, engineers reduced the frequencies by a factor of 1000/1001. A broadcast at 30 frames per second became, technically, one at 29.97 frames per second (29.97 = 30 × 1000/1001).

So there was a method to this madness, but it created some complications for timecode. The most obvious problem is that you can't have a fractional frame; every video has a certain number of whole frames, which must be counted as whole frames in timecode. How, then, do you broadcast at 29.97 frames per second but still count 30 frames per second?

You simply stop counting every once in a while—specifically, you drop 18 frame numbers every ten minutes (see "The math" for more detail). This is known as the Drop-Frame format, and it keeps your timecode in sync with the actual playback time. The Drop-Frame format is something of a misnomer—it drops frame *numbers* from the timecode, not actual frames of video. Physically lost frames of video, commonly referred to as dropped frames, usually occur during video capture or playback as a result of inadequate hard-disk and processor speeds (but are generally becoming a thing of the past with newer, faster hardware). So just remember that Drop-Frame and dropped frames are two very different beasts.

To navigate to any given frame by specifying timecode, click the timecode display in any of Premiere's windows, enter a new timecode, and press Enter.

00:00:04:00 The source footage

In Premiere, you can get timecode onto your footage in a few different ways. If you're using Premiere to digitize videotape using Batch Capture and device control (in which Premiere can control the tape deck), the transfer of timecode is automatic—Premiere stamps timecode on the frames of your source clip according to the electronic timecode of the source tape. This is the best way to go, but device control requires hardware that can be quite expensive.

Without device control, you have to use Premiere's Movie Capture option (choose Movie Capture from the Capture submenu of the File menu), which stamps timecode on the first frame of your captured video at 00:00:00:00, a number that might not match the original videotape. But all is not lost. Premiere lets you specify any timecode for any frame, once you've imported the clip, so that you can match timecode to the original. Here's how to do it.

1. In Premiere, open the clip in the Source view of the Monitor window. To specify a timecode for a specific frame, drag the shuttle slider to that frame.

01:23:32:10 The math

For those interested, here's the math that lets drop-frame timecode compensate for the difference between the frame rate of 29.97 fps for real-time playback and the counting scheme of 30 fps.

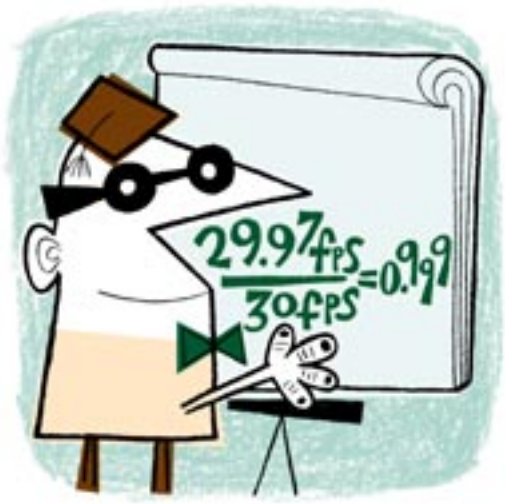
The frame rate of 29.97 fps is 99.9 percent as fast as 30 fps. In other words, it is 0.1 percent (or one-thousandth) slower.

29.97 fps ÷ 30 fps = 0.999 (or 99.9%)

One hour's worth of video played at a "true 30 fps" contains exactly 108,000 frames.

(30 frames/sec) × (3,600 sec) = 108,000 frames

But if you play back those same 108,000 frames at 29.97 fps, they will take longer than one hour to play.



(108,000 frames) ÷
(29.97 frames/sec)
= 3,603.6 seconds
= 1 hour and 3.6 seconds

This, of course, is the problem. How do you compensate for those extra 3.6 seconds? Let's take a closer look. The final timecode for 108,000 frames playing at 29.97 fps is 01:00:03:18. Thus, after an hour, it is 108 frames (3.6 seconds) too long. This makes sense: 108 frames out of 108,000 is one-thousandth of the total, which is exactly the ratio we showed above.

Now let's apply that discrepancy to one minute of video. Exactly 60 seconds of video at 30 fps contains 1,800 frames. One one-thousandth of that is 1.8. Therefore, by the end of one minute you are off by 1.8 frames. Remember, of course, that frames are indivisible; you cannot adjust by a fraction of a frame. But if you're off by 1.8 frames every minute, you *can* adjust by 18 frames every 10 minutes.

To do this, you drop two frame numbers every minute *except* the tenth minute. This way, by the ninth minute, you have dropped all 18 frame numbers. On the tenth minute, you don't drop anything. And then you repeat it for the next ten minutes, and so on. The frame numbers dropped are the first two of the minute (00:00:01:00 and 00:00:01:01). So when you're using Drop-Frame timecode, you'll see that your counter goes from 00:00:00:59 to 00:00:01:02.

2. Choose Timecode from the Clip menu. Enter the timecode, select the frame rate and format, specify where the timecode starts (at the current frame or at the beginning of the clip), and click OK. Premiere automatically renumbers the timecode.

In some cases, you may be capturing video from tape that has only a burned-in timecode (also known as a *window dub*) that's actually superimposed on each video frame. Typically, such tapes are created for offline editing, so that you can watch the tape at home using a VCR that doesn't read electronic timecode—you simply record on paper the start and end times of the footage you want to use, and then go back to the studio. If you don't have immediate access to the original tape, you can capture the window-dub version for editing a rough, low-resolution cut in Premiere; later, you can replace the low-resolution version with the original tape, without the burned-in timecode.

If you're capturing a tape that contains only burned-in timecode, you have a couple of options for adding timecode to the digitized file. On a Macintosh, you can use Premiere's optical character-recognition feature, which will read the timecode from each frame and apply it to the resultant clip. For detailed steps, see page 108 of the *Adobe Premiere 5.0 User Guide*.

An alternative for both platforms is to use the steps described above for manually setting a timecode, after you've captured window-dub tape. Go to the first frame of your clip, read the timecode from the window dub, and then enter the timecode in Premiere for that first frame.

To ensure accurate timecode when using device control, make sure your system is calibrated (see page 110 of the *Adobe Premiere 5.0 User Guide*).

00:00:05:00 The display

Once you've imported your captured clips into Premiere, you need to set both a time display and a timebase for your project. The timebase specifies the number of time divisions per second for editing, while the time display specifies the display format for the timecode. In almost all cases, you will want to match the timebase with the corresponding time display.

To set both, choose General from the Settings submenu of the Project menu, and then choose the appropriate timebase from the Timebase menu. The setting in the Time Display menu is automatically selected to match the timebase. For example, if you choose the NTSC broadcast standard of 29.97 fps for your timebase, Premiere automatically chooses 30 fps Drop-Frame timecode for your time display. Premiere supports all of the SMPTE formats.

To double-check which timecode you're using (Drop-Frame or Non Drop-Frame), you can simply look at the timecode display. If there are semicolons between the time divisions (for example, 01;23;17;04), then you're using Drop-Frame. If there are colons between the divisions, you're using Non Drop-Frame.

00:00:06:00 The end

In the same way that accurate numbers are required for addresses and good cooking, accurate timecode is essential for precise video editing. Certainly, timecode can be a bit confusing at first. But once you see it in action (maybe in clips from your new cooking show, *In the Kitchen with Aunt Sophie*), it really does become much less like voodoo and much more like the straightforward counting scheme it is. ◆

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