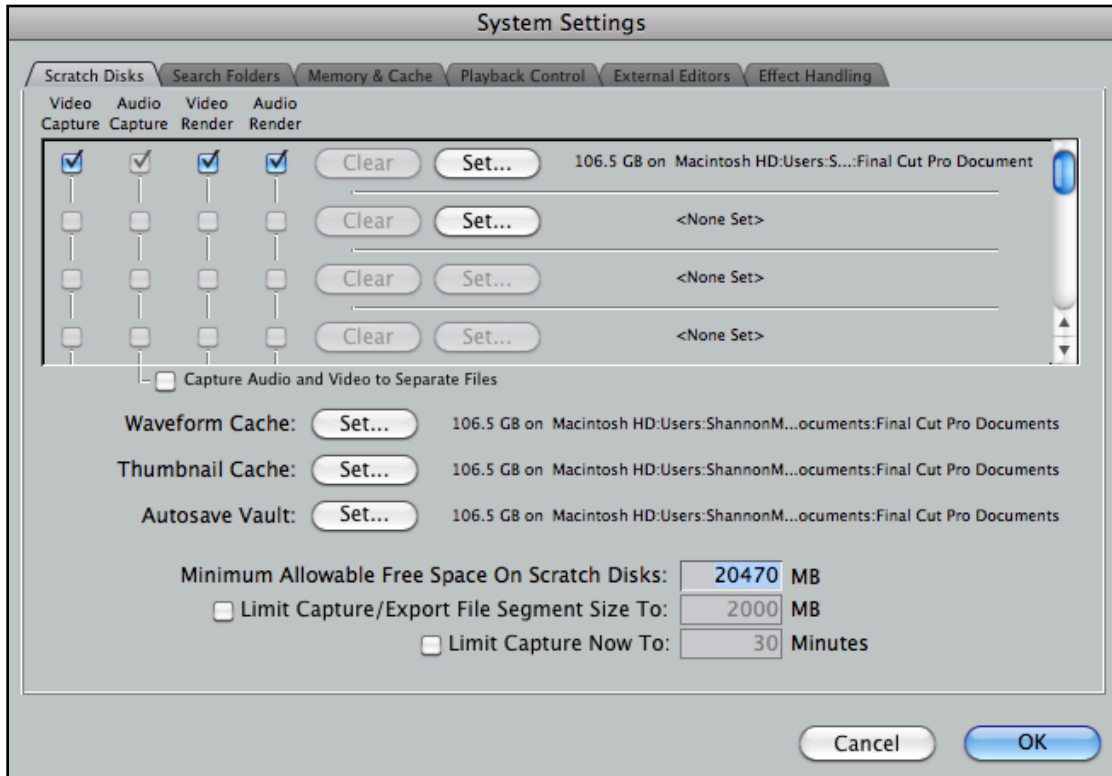


Working with Scratch Disks in Final Cut Pro 7

In my day-to-day dealings consulting for several post-production facilities and independent film makers, it still amazes me how little is known about video specifications and storage needs. I want to take this opportunity to dive into the “need to know”s before starting to edit your program.



System Settings (Shift + Q)

In Final Cut Pro it all starts with the **Scratch Disks** Tab in the *System Settings*. Before we can dive into this window we need to talk hardware. I know this has made several editors sink in their seats. Stay with me. This is valuable information that can save you time and mounds of head-aches in the future.

Before you start to edit you should know what kind of footage you will be given. There are many different types of footage and they all have different *bandwidth* and storage requirements.

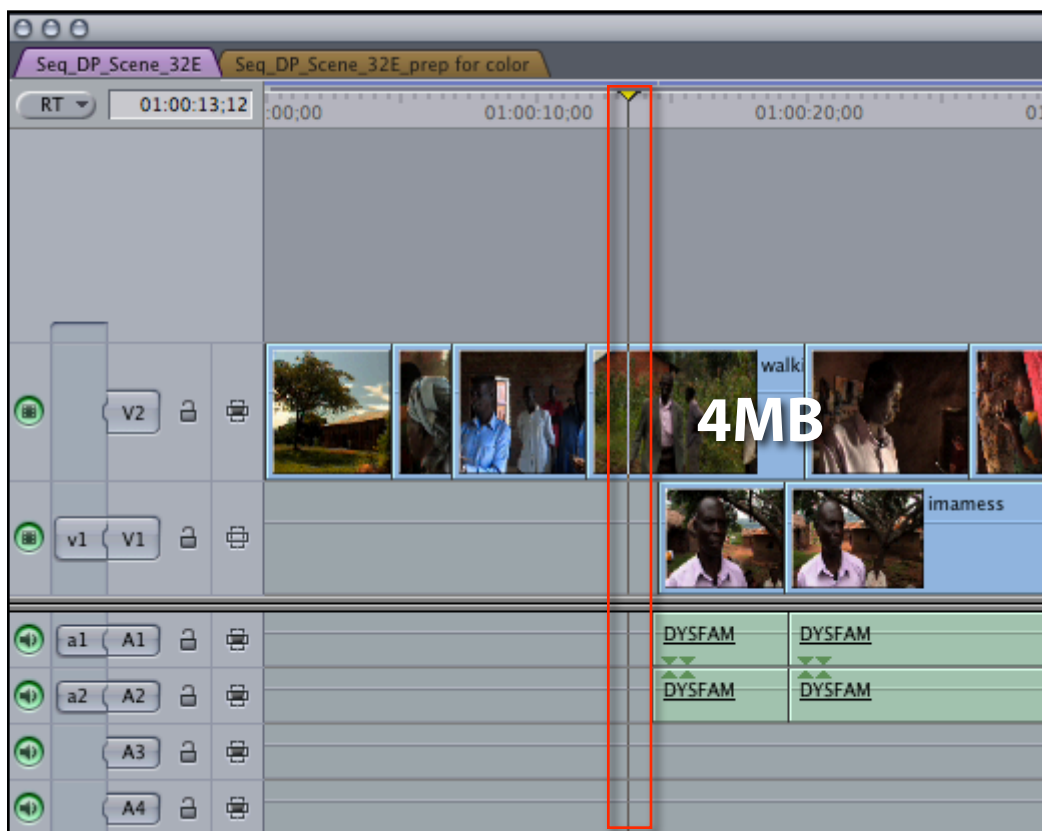
For example, a **DV-NTSC** clip weighs in at around *3.75MB/sec.* for playback and requires *13GB* of storage space per hour of footage. Where something like **REDCODE** from the RED ONE camera weighs in at *36MB/sec.* and requires *97.8GB* per hour. That's a big difference! In the chart below are some of the most common *Standard Definition* formats and their requirements. There are many factors that play into the *bandwidth* and file size, such as *Bit-Depth, Color Sampling, and Compression Scheme*. All things an editor should know in order to make sound judgment calls on isolating issues one may encounter with their Final Cut System.

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VIDEO Format	Bit Depth	Color Sampling	GOP or I frame	Data Rate	Storage Per/Hour
SD					
DV NTSC	8	4:1:1	I Frame	3.75 MB/sec	13 GB
DV PAL	8	4:2:0	I Frame	3.75 MB/sec	13 GB
DVCPPro - 50	8	4:2:2	I Frame	7.5 MB/sec	27 GB
Uncompressed 8-bit SDI	8	4:2:2	I Frame	20.2 MB/sec	72 GB
Uncompressed 10-bit SDI	10	4:2:2	I Frame	26.7 MB/sec	96 GB
ProRes 422 (VBR)	10	4:2:2	I Frame	5.5 MB/sec	19.2 GB
ProRes 422 HQ (VBR)	10	4:2:2	I Frame	8.0 MB/sec	28.2 GB

SD Formate comparison chart

As seen from the chart above, we start with a bandwidth of 3.75MB/sec. Let's round it to 4MB/sec. to make it easier. Once I transcode to ProRes HQ, it basically doubles the bandwidth at 8.0MB/sec. Now that may seem small to the inexperienced editor. What we need to factor into the equation is the amount of real time streams we want to be able to edit in real time.



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So here is how it works in layman's terms. When the playhead is over a DV-NTSC clip in the timeline as in the image above the clip needs your harddrive to pump out 4MB/sec *note this is Video and Audio*.

When the playhead hits more then one track as seen in the image below, a clip will now need yet another 4Mb/sec, so **4MB + 4MB = 8MB**. Now the number of streams we have determines the amount of bandwidth required.



2 Streams of DV-NTSC

Just to put things in perspective and drive the point home, let's say we have a four camera shoot and we want to use the multi-cam feature in Final Cut. A multi-clip in Final Cut requires all the clips within that multi-clip to playback in real time. So 4 clips at 4 MB/sec would require 16MB/sec. That can be very taxing on your drives.

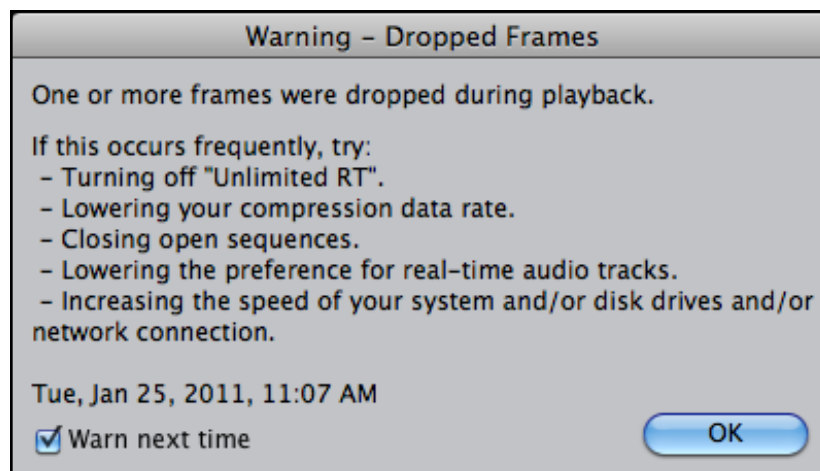
It is true not all drives are created equal, but for the Final Cut editor it how we plug our drives that makes all the difference. In the chart below we can see the amount of bandwidth we can get from each bus.

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Protocol	SPEED
USB 1.0 or 2.0	To Slow for Video (Mac)
FireWire 400	20 - 25 MB/sec
FireWire 800	40 - 50 MB/sec
SATA	75 - 90 MB/sec
SATA RAID (MacBook Pro)	100 - 150 MB/sec
SATA RAID (MacPro)	225 -400 MB/sec
PCI Express	up to 500 MB/sec
SAS RAID	200 - 400 MB/sec
SCSI RAID	200 - 450 MB/sec
Fiber Channel RAID	400 - 1400 MB/sec

USB on the Mac is too slow for constant transfer rate of data. Apple has put a cap on the transfer rate. USB on the Mac is used for keyboards and mice.

So lets get go back to our scenario where we had the multi-clip. At **Firewire 400** I can expect to get somewhere between *20-25 MB/sec*. Let me just say you will never get *25 MB/sec*. The firewire protocol is very chatty. We need to keep *20%* of the bandwidth for communication between the drive and Mac. This is referred to as back-channel communication if you'd like to do your own research on it. SO that means we get at most *20 MB/sec*. We are very close to our max with this *16 MB/sec*. multi-clip. So don't be surprised when you start to see this window....



Working with Scratch Disks in Final Cut Pro 7

Dropped Frames occur when what we ask Final Cut to playback more real-time streams than the system can handle. That's where the **RT** menu comes into play which we will cover in our next article.

Well now I know if this were the **REDCODE 36** clip I wouldn't be able to play it back from a Firewire 400 drive. WOW! If you're making the jump to the RED, it's time to rethink that budget. You're going to need some newer high-speed drives.

Just in case you haven't caught on yet, the "36" in **REDCODE 36** is for 36 MB/sec.

I know if I am going to be handed a RED CF card or drive I'm going to need at least a *Firewire 800* drive to work from. Again, if we look at the chart above, that means I will only be able to play back one stream of **REDCODE**.

When you reach the level of editing RED it's time to bypass Firewire all together. We still use Firewire for transferring to a backup drive, but it is not expected for editing RED.

It's time to start thinking about something like ESATA. With a single drive over SATA I can expect 70-90 MB/sec. or with a RAID configuration I can get *100-150 MB/sec* when used with a **MacBook Pro***.

***NOTE: only the 17" inch Macbook Pro currently support the ESATA expansion cards**



I hope this knowledge I hope this will give you some perspective on the the fact that you need to be very aware of your hardware as it determines what a you will be able to do inside of Final Cut.