

8-bit vs 10-bit Color Space

8 bit vs 10 bit

This discussion will focus on film but some of the same issues apply to video work.

Most desktop systems work with 8 bits per color channel. That's 256 values per channel and with Red, Green, and Blue producing millions of colors. This applies to most video work as well. Some higher end workstations deal with 10 to 16 bits per color channel. 10 bits is 1024 per channel, 12 bits is 4096 per channel, and 16 bit is 32767 per channel. The reason for greater bits per channel is to provide finer steps between color values. This is most noticeable when transferring to film and viewing a smooth gradation, especially in the dark end.

Many deep color systems don't actually use the entire range. As an example the Cineon scanners provide 10 bit log images (0-1023 in values). Black is technically at 95 and white is at 685. That means that the values from 685 to 1023 are used only for whiter than whites (glares, hot kicks, etc) This range is meant to capture the entire dynamic range of the original film. This allows for radically adjusting the color/brightness at any point in the process. All of this simulates the film response curve and the typical film printing process. The heel and toe of the film have a natural curve and the straight line portion is the typical exposure range.

Linear versus Log

It's important to review a little bit about log versus linear in this discussion. Linear space means the computer values are incremented in the typical way. On an 8 bit system (256 values) 128 would be half the value of 256. This half exposure would be equivalent to 1 film f-stop. Stepping through this progression 256, 128, 64, 32, 16, 8, 4, 2, 1 is equivalent to 1 f-stop per number. This means that the dark end has very coarse increments and the high end has very fine increments.

If the pixel is in log space then each f-stop is the same number of values. 32, 64, 96, 128, 160, 192, 224, 256. This provides better response in the dark end and doesn't waste it on the high end. 8 bit log image is close to equivalent to 12 bits of linear image.

Displays

All of this becomes even more complicated when dealing with video or computer displays which typically have a gamma response. It's important to note that most display systems are limited to 8 bits per channel so even with greater color depth you won't see it on the monitor.

Using 8 bits for film work

Many companies do use 8 bit for film work. This is possible with some care. If you're dealing with 8 bit images then you'll want to do the major color timing (adjustment) when importing the images into your system. You can still do final color adjustments later but you won't want to 'print it up a stop'.

Avoid doing things that will increase quantizing. For example, performing a gaussian blur and then radically changing brightness or levels settings. This is especially true if you repeat this procedure multiple times (i.e. a number of gaussian blurs and brightness adjustments).

It's possible to use 8 bit log data to get better response. Most image processing assumes linear response but in most cases it doesn't matter since you're going by look and not scientific numbers. No matter what 8 bit system (linear or log) you're using many operations work the same. (Cloning, super cloning for wire removal, wire removal since these are using pixels in the same color space.)

Using 8 bits with 10-16 bit systems

Even if you're using 10 bit color space for most of your work it's still possible to use 8 bit software for certain functions. Things like rotoscoping produce a high contrast matte. This is almost black and white in reality. This can easily be imported into your deep color system with no quality loss. These can then be blurred and manipulated same as any other deep color image. If your roto mattes have significant tonal range (large feather amounts or heavy motion blur) there's a slight chance you could get some quantizing in going from 8 bit to 10 bits (i.e. 8 to 10 doesn't create the quantizing but can make it more apparent). But since these are being used as mattes and not directly filmed out it's unlikely these will be visible in the final product. The other option is to apply a slight blur in the deep color system to smooth this out.