



Codecs



What are codecs?

- Codec is a portmanteau of encode-decode
- A codec is a way of compressing and decompressing large amounts of data, most commonly with video, image, and audio files.
- A codec is unrelated to the file type (.mov, .mp4, .mpeg, .avi, etc...)
 - These are called “container formats”
 - a codec can be wrapped in more than one container format.
 - H.264, a common codec, can be within .mp4 or .mov.
- Video players decode the data so that it can be displayed as a video.
- Editor programs decode data so that it can be edited, and encode when you render out a video.



Types of codecs

- Lossy vs Lossless
 - Lossy - throws out data to achieve a lower bitrate. The data is then rebuilt to create a near identical copy of the original data.
 - Lossless - Compresses and decompresses the data while keeping the original quality. This comes at the cost of higher bitrates.
- Intraframe vs Interframe
 - Intraframe - Each frame is saved independently of other frames.
 - Interframe - The codec analyzes the content and reduces data by only keeping the information that changes between frames.
 - Interframe codecs take more processing power to decode

Channels - Information stored in codecs

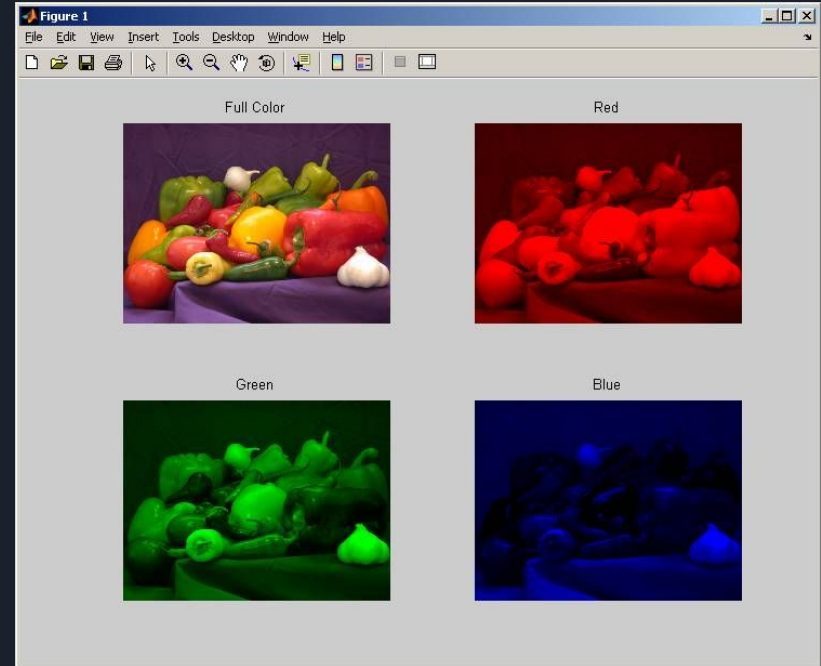
Your standard channels in a normal colour image are:

- RGB = Red, Green, Blue
- These channels come together create the full image

Additional channels store extra information.

- Alpha channel stores transparency
- Z-depth channel stores distance from the camera in 3D scenes.

The more channels a file has, the larger it will be.



Bit Depth

Refers to the **number** of colours per channel in a file

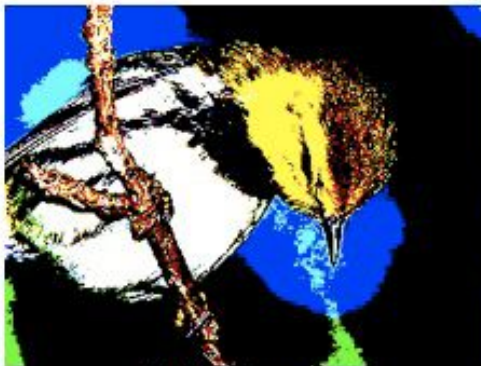
- 1 bit is 2 colors per channel
- 2 bit is 4 colors per channel
- 4 bit is 16 colors per channel
- 8 bit is the most common colour depth today
 - 256 colors... but that's not very many...
 - Each color channel (RGB), gets 256 colors.
 - $256 \times 256 \times 256 = 16.7$ million colors
- 10 bit is 1024 colors per channel, 1.04 billion total colors.
- 16 bit is 65,536 colors per channel, 281 trillion total colors
- 32 bit has so many colors it is effectively infinite.



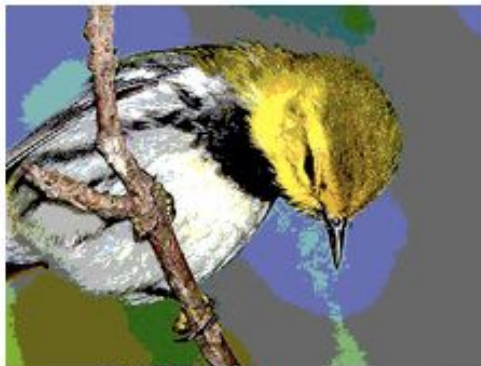
1 bit color - single channel



2 bit color - single channel



1 bit/channel



2 bits/channel



3 bits/channel



4 bits/channel

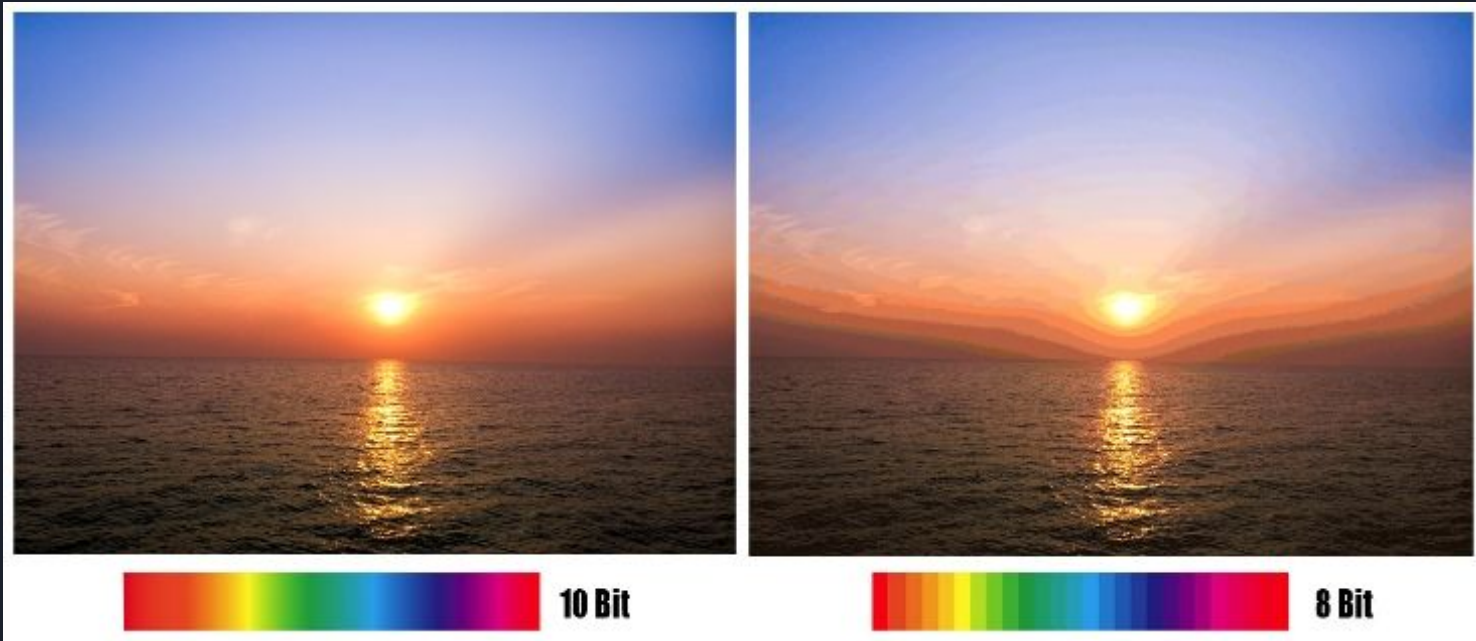


5 bits/channel



8 bits/channel

Bit Depth - Banding



Working with high bit depth images will result in smooth gradients and better calculations with special effects and color adjustments. With an 8 bit image, banding is more likely to show up the more adjustments you make to an image.



Bit Depth - Terminology in different programs

Different software often have different ways of talking about bit depth and alpha. For example, After Effects uses these terms:

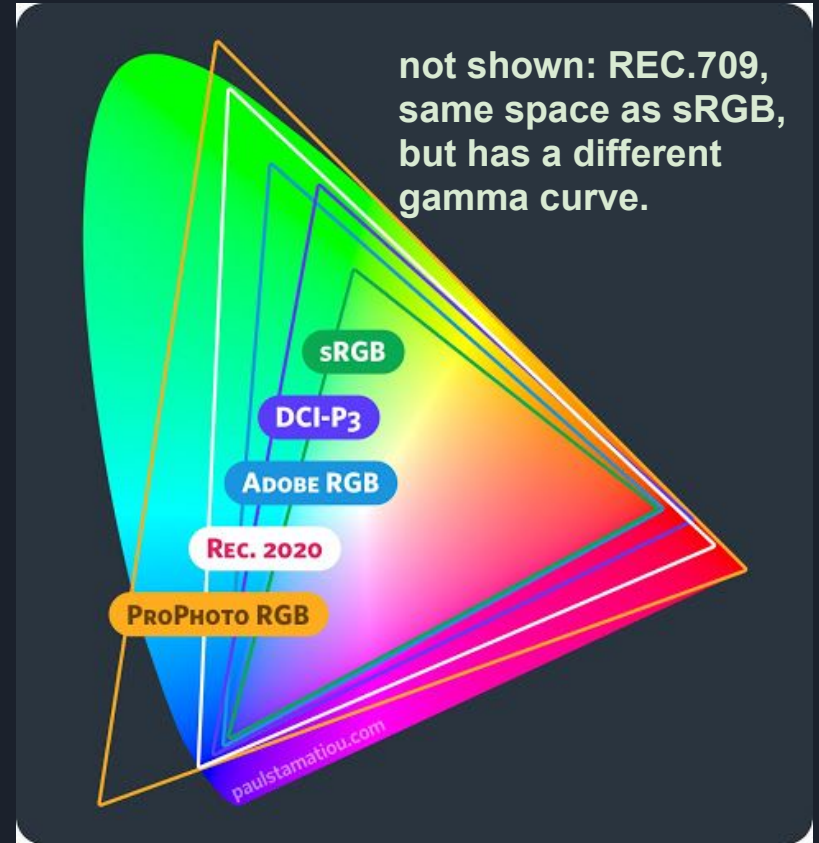
- RGB - this is the default.
- RGBA - this includes an Alpha channel.
 - “Millions of colours” - 8 bit colour
 - “Millions of colours+” - 8 bit colour + alpha
 - “Trillions of colours” - 16 bit colour
 - “Trillions of colours+” - 16 bit colour + alpha
 - “Floating Point” - 32 bit colour
 - “Floating Point” - 32 bit colour + alpha

16 bit colour should be your minimum, as it allows you to perform more colour adjustments without creating banding and other artifacts. EXR's (for 3D rendering) are natively 32bit and can hold more channels beyond RGBA (depth, refraction, specular, etc).

Color gamut

Refers to how **wide** the spectrum of colors you have access to.

- **sRGB** - Internet and consumer technology
- **Rec.709** - standard for HDTV and animation production
- **DCI-P3** - Digital theatre projection standard
- **Adobe RGB** - used by Photographers
- **Rec.2020** - Standard for UHDTV for 4k+
 - (This will be the standard to replace Red.709)
- **ProPhoto RGB** - used by Photographers





Video Codecs

Video Codecs

- H.264 is a delivery codec (.mp4)
 - compressed for small size and playback compatibility.
 - Very common, but bad for editing
- Quicktime Apple ProRes 422 is an intermediate codec (.mov)
 - A high fidelity intermediate between your source footage and your final deliverable. Intermediate codecs balance file size with quality, to allow for speedy editing/colour grading while still maintaining a high level of detail.
- Quicktime Apple Prores Proxy is a proxy codec (.mov)
 - A proxy is a placeholder for full quality/source footage when you are editing and don't have the space or power for full resolution editing. You would use a proxy in the timeline when you are editing, and then at render time, replace the proxy with the full-res footage.



File Management continued

An alternative to video is image sequences

- **Advantages:**
 - Each frame is a discrete file
 - If you find a mistake in one part of the sequence, you can just re-render those frames instead of a whole video.
 - Alpha channel is available at lower bit rates
- **Disadvantages**
 - Instead of one video file, you may have hundreds or thousands of images to deal with.
 - Depending on what your content and image format is, disk space requirements could be higher (or lower)



What file type should I use???

When exporting your animation from your program of choice, make sure to choose an option that has little to no compression.

Video files:

- Apple Prores 422 - More common on Mac OS, gaining support on Windows.
- DNxHR HQ - Windows equivalent to Apple Prores 422
- Animation Codec - Old and large, but gets the job done.

DNxHR 444, ProRes 4444 and ProRes 4444 QC are the only codecs (of Prores and DNxHR) with embedded alpha channels.

Image Sequences (great option for embedded alpha channel)

- PNG's
- EXR's
- TIF's (or TIFF's)



What files should I never use when editing??

- .mp4's with the H.264 codec. It is compressed, lossy, and your computer must decode (uncompress) the file before it can edit the video.
- JPEG's. Compressed, lossy, and loses data every time you edit it! (moving/copying is okay)
- .mp3 - compressed, lossy audio file
- Gifs - Premiere *hates* gifs