Technical Brief

How does compression work?

Each image you see on a computer screen, plasma or LCD TV is made up of 3-color dots referred to as pixels. Each pixel has properties such as brightness (called luminescence) and color (hue). If one views a primary color, say green, a robust pixel may be able to represent many shades of it from very dark (almost black) to very bright. But there are also many greens, blue-greens, yellow-greens, etc. If you extend this idea to the full spectrum of colors and shades, nearly 20 million can be discerned by humans. A pixel capable of generating 20 million colors is complex. In video, a pixel is comprised of a luma component and two of the three primary color components (typically red and blue). A MPEG compressor will first group a small square of pixels of an image called a macro-block. A macro-block may be analyzed and replaced by an array containing an average luminescence (luma) and hue as well as a set of values representing how the color and shade varies along the vertical and horizontal sides of the square of pixels. A typical macro-block groups 256 pixels (16x16) and compresses these values to 33, not quite 8:1. The macro-block replaces the 256 original image pixels. Eight to one compression isn't enough though. One needs upwards of 75:1 compression to stream a 1080i/60 standard video into a typical cable channel or 100Mb Ethernet. One mechanism (a part of H.264) is to compress a reference picture, noted as "I", like we just described and the next picture as only the difference between it the I- picture. The differential picture noted as "P", is dependent on the predecessor I-picture and could yield a compression of more than 200:1. The B-picture in Figure 1 is another synthetic picture that embodies the differences forward and backward between pictures. These too are highly compressed "pictures". The number of B and P pictures between I-pictures is referred to as a group of pictures (GOP). The longer the GOP, the more impact on the average compression there is. However the longer the GOP, the more vulnerable the series of pictures are to loss if the I-picture is corrupted.

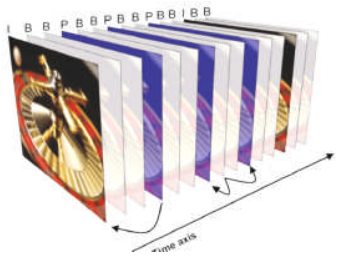

Figure 1: Group of Pictures from Video Compression by Djordje Mitrovic University of Edinburgh

The standard video you see from DVD and TV shares 1 color sample (red & blue) with 2 luma samples. This common image sampling method is called 4:2:2. More data can be eliminated by sharing one color sample with four (4) luma samples; 4:2:0 encoding. Although the absolute resolution (pixels) is unchanged, shading detail is lost.

If more compression is needed to fit in the transport channel, the size of the macro-block can also be increased. One can see this effect on your TV when there is a lot of scene activity; live sports are a good example. If one looks at the background, pixelization (large macro-blocking) can be seen; lost resolution. There is much more to this subject, but these concepts give you an idea of what happens to the images. Macro-block size, color sampling ratio, and GOP are all used dynamically by compressors to result in a data rate that fits in the available transport channel, or to manage archive storage space.

It is easily seen that the result of compression can be a permanent loss of detail information at the destination whether a TV or stored video on a DVD. If the detail is important to you, if each image must stand alone in quality, if the original images captured by the camera is what you need, compression may not work for you.

The ITS 6520 recorder captures and stores uncompressed video all the way up to 1080p/60 (3G). Each image is there, all of the pixels are kept and all of the color shade information is complete. No imaging compromises, nothing to fool the eye. Learn more about this product at http://www.itsamerica.com/Technical_Descriptions/6520fly.pdf

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