Video Resolution - An Overview

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The Basics

A television or recorded video image is basically made up of **scan lines**. Unlike film, in which the whole image is projected on a screen at once, a video image is composed of rapidly scanning lines across a screen starting at the top of the screen and moving to bottom. These lines can be displayed in two ways. The first way is to split the lines into two **fields** in which all of the odd numbered lines are displayed first and then all of the even numbered lines are displayed next (this is in **analog** video formats. Digital video switches this, displaying even number lines first then odd number lines- this is what is meant by **field dominance**), in essence, producing a complete frame.

This process is called **interlacing or interlaced scan**.

The second method, used in digital video recording, digital TVs, and computer monitors, is referred to as **progressive scan**. Instead of displaying the lines in two alternate fields, progressive scan allows the lines to displayed sequentially. This means that both the odd and even numbered lines are displayed in numerical sequence.

Analog Video: NTSC/PAL/SECAM

The number of vertical scan lines dictates the capability to produce a detailed image, but there is more. It is obvious at this point that the larger the number of vertical scan lines, the more detailed the image. However, within the current arena of video, the number of vertical scan lines is fixed within a system. The current analog video systems are **NTSC, PAL, and SECAM**.

NTSC is based on a 525-line, 60 fields/30 frames-per-second (**29.97**), at 60Hz system for transmission and display of video images. This is an interlaced system in which each frame is scanned in two fields of 262 lines, which is then combined to display a frame of video with 525 scan lines. NTSC is the official analog video standard in the U.S., Canada, Mexico, some parts of Central and South America, Japan, Taiwan, and Korea.

PAL is the dominant format in the World for analog television broadcasting and video display and is based on a 625 line, 50 field/25 frames a second, 50HZ system. The signal is interlaced, like NTSC into two fields, composed of 312 lines each. Several distinguishing features are one: a better overall picture than NTSC because of the increased amount of scan lines. Two: since color was part of the standard from the beginning, color consistency between stations and TVs are much better. There is a down side to PAL however, since there are fewer frames (25) displayed per second, sometimes you can notice a slight flicker in the image,

much like the flicker seen on projected film. Countries on the PAL system include the U.K., Germany, Spain, Portugal, Italy, China, India, most of Africa, and the Middle East.

SECAM is the "outlaw" of analog video standards. Like PAL, it is a 625 line, 50 field/25 frame per second interlaced system, but the color component is implemented differently than in either PAL or NTSC. Countries on the SECAM system include France, Russia, Eastern Europe, and some parts of the Middle East.

The number of **scan lines, or vertical resolution**, of NTSC/PAL/SECAM are constant in that all analog video recording and display equipment conforms to the above standards. However, in addition to vertical scan lines, the amount of dots displayed within each line on the screen contributes to a factor known as **horizontal resolution** which can vary depending on both the ability of a video recording/playback device to record the dots and the ability of a video monitor to display dots on a screen.

Digital TV (DTV) and HDTV

With the advent of DTV and HDTV, video resolution has become more confusing. Just as in analog video there is both a vertical and horizontal component to digital video resolution. However, the total image resolution displayed in DTV and HDTV is referred to in terms of number of **pixels** on the screen rather than lines.

Digital TV Resolution Standards

In current digital TV standards, there are a total of 18 video scan rates that are approved by the FCC for use in the U.S. system. Fortunately, for the consumer, and for this Guide, there are only three that are commonly used. The three **vertical scan line systems used in digital TV** are **480p** (480 lines vertically scanned in a progressive fashion), **720p** (720 lines vertically scanned in a progressive fashion), and **1080i** (1,080 lines scanned in an interlaced fashion).

Based on vertical scan rates, digital TV has much more capacity for a finer detailed image than that of analog TV. However, In order to display the raw scan lines, a video monitor has to be able to reproduce the full detail of the incoming DTV or HDTV program material. In addition, true HDTV is also dependent on a monitor that displays the image in a 16x9 screen shape. However, there are also HDTV monitors in the traditional 4x3 shape, in which case a 16x9 image is displayed in a letterbox format, with black lines on the top and bottom of the screen. Another factor on how a digital TV image is displayed is the actual size of the screen. Basically you can fit more dots on a 50-inch Plasma Screen than a 27-inch Direct View DTV.

HDTV vs EDTV

So, even though you may be inputing a 1080i image into your HDTV, your TV

may not have the ability to reproduce all the dots within those lines. In this case the signal is often reprocessed (upconverted or downconverted) to conform to the number and size of dots (pixels) on the physical screen. At full resolution on a 16x9 screen, a 1080i image is comprised of 1920x1080 pixels (about a two-megapxiel field).

However, if your monitor is not capable of reproducing the total pixel field, then the image is scaled to fit the number of pixels in the display monitor's pixel field. So, an HDTV image of 1920x1080 can be scaled to fit 1366x768, 1280x960, 1024x768, 852x480, or other pixel field. The relative loss of detail actually experienced by the viewer will depend on factors such as screen size and viewing distance from the screen.

In essence, when purchasing an HDTV, it is not only important to make sure that you can input 480p, 720p, or 1080i signals, but you must also consider the pixel field of the monitor itself (and whether upconversion/downconversion is used).

EDTV Plasma

To go on further detail on this, televisions that have to down convert an HDTV signal (such as 720p or 1080i) to a pixel field of 852x480 (480p) for example, are referred to as EDTVs and not HDTVs. **EDTV stands for Enhanced Definition Television**. Specifically, If you check the newspaper or internet ADs for "bargain priced" Plasma televisions, for instance, you will notice that they are often EDTVs and not HDTVs. These sets can accept HDTV input signals, but must down convert them to EDTV resolution to display them on the screen.

EDTV Video Projection

In addition to EDTV plasma television, budget-priced video projectors often are capable only of EDTV resolution and are not capable of projecting a true HDTV-resolution image. Just as with EDTV plasma televisions, budget video projectors will often have the capability of inputting an HDTV signal through HD-component, DVI, or HDMI input connections. However, if the projector has a native pixel resolution of 640x480, 852x480 or 1024x768, the video projector will have to scale a 1080i (1920x1080) or 720p (1280x720) HD image down to fit its lower native pixel resolution, in order to project it onto the screen.

Resolution Requirement For True HD Image Display

On the other hand, if televsions or video projectors convert 1080i signals to 720p, they are still referred to as meeting HDTV specs. Most LCD flat panel televisions, for example, currently have a native pixel resolution of 1280x720 (720p). So, when faced with a 1080i (1920x1080) input signal, the LCD television will convert (scale) the signal to 720p to display it on the screen. Since the scaling is within the HDTV spec, the television is correctly labeled as an HDTV. Basically, if a television or video projector has a native pixel resolution of 1280x720 or higher, it definitely has true HDTV resolution capability.

DVD Resolution Upscaling and The Bottom Line On Video Resolution

DVD Resolution Upscaling

Although standard DVD is not a high resolution format, the capability of the a growing number of DVD players to output a video signal in the 720p or 1080i format allows the DVD player's video output to more closely match the capabilities of today's HDTVs.

Although upscaling standard DVDs is not the same as watching DVDs in true-high definition, as current DVDs are not recorded in high definition, you will experience increased detail and color you didn't think was possible from a DVD player; at least until true high definition DVD players and movies come out.

However, this function works best on fixed pixel displays, such as LCD or Plasma sets, the upscaling may result in harsh images on standard CRT and Projection sets. In addition, if your television has a native display resolution other than 720p or 1080i, the TVs video processor will rescale the incoming signal to its own specification, which can also yield different results on the final, displayed television image.

Don't Get Confused

If you are still a little confused, you are not alone.

Remember, video resolution can be stated either in lines or pixels. However, don't get caught up in all the video resolution numbers. Look at it this way, VHS looks great on a 13-inch TV, but "crappy" on a big screen.

In addition, resolution isn't the only factor that contributes to a good TV image. Factors such as color accuracy, contrast ratio, brightness, maximum viewing angle, and whether the image is interlaced or progressive, all contribute to quality of the picture.

You can have a very detailed image, but if the other factors mentioned aren't sufficiently present, you have a lousy TV. Even the best TVs can't make a poor import source look good. In fact, ordinary broadcast TV (with its low resolution) sometimes looks worse on an HDTV that it does on a good, standard, analog set.