Progressive Scan and HDTV

The functions and benefits of progressive scan and why it will be beneficial for HDTV

Date: May 2004
Version 1.0
TB-2005-05-PROGRESSIVE-SCAN-1029-EN
Computing devices and home entertainment systems are beginning to speak the same language, namely digital audio and video. This step toward digital will transform home and entertainment networking in the coming years.

One key technical aspect of this development is progressive scan for enhanced digital video, whether for DVD playback or HDTV (High Definition Television). With this development, we will slowly but surely see the disappearance of the television as we know it today and the increasing use of LCD and flat-panel plasma displays as well as new digital projectors.

This technology brief explains the functions and benefits of progressive scan and the reasons why it will be beneficial for HDTV.

Interlaced versus Progressive Scan (PS)

Like older Cathode Ray Tube (CRT monitors), today’s standard DVD players and televisions use interlace scanning to produce a picture. This means that the when video is streamed to the device, the component first provides all of the odd-numbered lines for a frame and then all of the even-numbered lines. Thus, it takes two fields (passes) to build one frame of video.

By contrast, a progressive scan device provides all the lines in one clean sweep, painting the entire frame at once. Thus, it takes one field to build a frame of video. Today, progressive scan is most commonly used by LCD screens. Newer DVD devices, PS projectors and HDTV-ready TVs also use progressive scan.

Three of the main benefits of progressive scan are immediately evident:

- **Eliminates flicker**: as progressive scan signals paint and entire frame at once, they can avoid the flicker often noticeable with interlaced systems, an occurrence produced by the “scan lines” or the lines of black between the video information.

- **Smoother, sharper, brighter picture**: this is because only one scan is required to produce the image.

- **Capable of displaying twice as many frames per second compared to interlace scan methods**

Viewing broadcast television, DVDs and film

The concept of frames per second is an essential one for DVDs, broadcast media and films. Standard television broadcasts in Europe generally take place using the PAL (Phase Alternating Line) format. PAL uses 625 horizontal lines (575 of which are displayed) at 25 frames per second interlaced. This same format is also used for VHS tapes and DVD movies. In North America and Japan, the NTSC standard is used, with 525 horizontal lines (480 of which are displayed) at about 30 frames per second interlaced. Each of these rates naturally fits the scan rates of the interlaced television in the respective geography.

To put this in the context of an interlaced versus a progressive scan display, where standard NTSC video displays 30 frames (60 fields) per second, progressive scan displays 60 full frames per second. For PAL, this means interlaced is 25 frames and progressive scan is 50 frames.
These rates become especially important when we think about the possibilities for viewing video sources that operate at a different number of frames per second on a given display. For instance, let’s take the example of film. The traditional frame rate for a film is 24 fps progressive scan rate, which does not conveniently fit into an interlaced or progressive scan rate for either NTSC or PAL television standards.

In the NTSC format, to prepare a film for use with an interlaced display or conventional television broadcast, a technique called 3:2 pull-down is implemented. In the case of NTSC, this consists of a number of steps:

- The 24fps is up-converted to 60fps: each frame in the original is either duplicated or triplicated to accomplish this.
- The video stream is condensed to a standard 30 fps: each pair of frames is merged to produce this result.

Obviously, this process will merge two frames that are different at regular intervals. This process of “frame mixing”, as it is called, results in a blurred or jagged image, especially when swiftly moving images are being displayed (as the differences between the information in each frame are greater than with a static image).

Preparing the information for use with a NTSC progressive scan system still requires the up-conversion of the 3:2 pull down, but does not require the condensation as the progressive scan operates at 60 fps efficiently. Therefore, the frame mixing problem does not occur, and the resulting viewed image is truer to the original (sharper and crisper, also without mixed frames).

Film to PAL conversion usually involves speeding up the film (it runs about 4.17% faster) from 24 fps to 25 fps and using a pitch correction for the audio. Thus, 3:2 pull-down is rarely implemented for interlaced display. Nonetheless, progressive scan can offer an enhanced viewing experience as we have already seen from the discussion of interlaced versus progressive scan.

**Devices ready for Progressive Scan**

Since most televisions typically employ an interlaced display, until recently, the accompanying devices, such as VCRs and DVD players, are configured to provide interlaced streams of data.

However, with approaching HDTV standards (even the launch of a few services already in Europe), consumers can now purchase HDTV-ready televisions, as well as LCD and plasma displays, progressive scan DVD players and projectors that support progressive scan. It is important to note that in order to benefit the viewer needs both a source providing progressive scan image data (i.e. a PS-capable DVD or an HDTV signal) and a PS display (i.e. HDTV-ready TV).

Already many North Americans have ample reason to consider switching to a progressive scan DVD player and display, if only to enjoy a better cinematic experience. For Europe, however, HDTV will be the most compelling reason to take up the benefits of progressive scan. Indeed, IMS Research predicts that by 2008 it expects that the EMEA region will
account for approximately 4.7 million HDTVs shipped, or about 15% of total worldwide shipments. Next, we take a closer look at HDTV.

“Focus” on progressive scan for HDTV

HDTV is not so much a standard technology as it is a generally accepted idea: to deliver much improved image quality to television viewers. HDTV’s “taller” height (more scan lines from top to bottom) and wider field of vision (16:9 aspect ratio instead of 4:3) means much, much more video information on the screen at once and thus the viewer sitting the same distance away will see not only a richer picture, but also a higher quality one (as artefacts in the display image will be less noticeable).

There are many standards that have been proposed to implement HDTV systems, but in recent years the number of competing schemes has generally been winnowed down to a small number. In Europe and North America that “Grand Alliance” standard signals settled upon are 1080i and 720p: meaning either a 1080 line interlaced signal (divided into two passes of 540) or a 720 line progressive scan signal.

“HDTV-ready” televisions typically support both a 1080i mode and a 720p mode, and those that do support 720p can today take full advantage of progressive scan video output, whether from an HDTV television station or from a progressive-scan capable digital video component (DVD player for example, or PS-capable digital video recorder).

With the greater amount of video data available with HDTV broadcasting, the advantages of progressive scan virtually becomes a necessity, allowing the viewer to enjoy a crisp, clear, flicker-free image.

In the future, it is sensible also to expect that manufacturers of computer systems will start to build HDTV tuners and progressive scan support into their products, as the notion of digital media convergence becomes more and more widely accepted. Thus, in a few years it is possible that a widescreen notebook might be commonly used for HDTV, along with the S/PDIF port to output digital audio for a true surround sound digital movie experience.

Conclusion

With the increasing adoption of DVD as a mainstream format for viewing movies and other audio-visual entertainment and the coming promise of HDTV and the convergence of computing, digital media, and television in the home, PS-capable television displays are becoming more commonly available.

More reading:

To learn more about HDTV services available in Europe today:

- [http://www.quali-tv.com](http://www.quali-tv.com)
- [http://www.euro1080.tv/index.htm](http://www.euro1080.tv/index.htm)

For the IMS report, see: