

Glossary of H/DTV Terms

The following are some descriptions for terms of video and audio concepts as they relate to DTV. I wrote this Glossary for the Reference Guide Issue of the HDTVetc Magazine a few years ago and have been updating it over the years, now updated as of May 2007.

480i: SDTV format of 480 interlaced visible lines of 704 total pixels each (in 16:9 or 4:3 aspect ratio), or of 640 total pixels each (in 4:3 aspect ratio). 480i is per frame (240 lines x two fields) at 30 fps (frames per second). 480i/30fps is similar to interlaced DVD quality. Comparatively, NTSC color television is also 480i visible lines but is analog in a 4:3 aspect ratio with 450 pixels edge to edge (also measured as 340 TVL lines of horizontal resolution per picture height).

480p: EDTV format of 480 progressive visible lines of 704 total pixels each (in 16:9 or 4:3 aspect ratio), or of 640 total pixels each (in 4:3 aspect ratio). 480p is per frame at 24, 30, or 60fps. The 480p/60fps format is similar but in theory it should be better than progressive DVD quality, because the DVD progressive is the result of re-interleaving/line-doubling 480i/30fps stored DVD images, not 480p/60fps as EDTV, which should have better temporal resolution suitable for fast action content (like 720p is). This format was originally a SD format, in late 2000, the CEA promoted it to an EDTV level created for 480p.

5c: Copy-protection protocol used by the IEEE1394 digital connection. Also known as DTCP. The name originates from the group of five companies that developed the standard.

720P: HDTV format of 720 progressive visible lines of 1280 total pixels each in 16:9 aspect ratio. 720p is per frame at 24, 30, or 60 fps. ABC and ESPN are broadcasting in 720p/60fps. 720p is considered a better format for fast action images like sports due to higher temporal resolution than the other commonly used HDTV format (interlaced 1080i).

The higher temporal resolution of 720p allows the format to complete an image frame in 1/60 of a second while 1080i is only drawing 540 lines with half of the information of the frame of the format. On the next 1/60 of a second the 720p could record complete detail of a different fast moving image, while the 1080i would be registering picture information of only the second set of 540 lines containing only half of an image that could also have moved fast enough to produce interlace artifacts when putting the two fields together.

810i: In late 2000, when the CEA created the additional EDTV level with the DTV formats, there were a number of 4:3 TV sets that manufacturers labeled HDTVs but only showed 810i lines of a 16:9 1080i image (25% less in the vertical resolution), using a letterbox approach to convey the rectangular widescreen geometry of the HD image within the 4:3 frame of the TV.

The remaining 270i lines (1080i minus 810i) of the TV set were wasted on scanning black information for the top/bottom bars, instead of using the lines for the benefit of the image. The concept is similar to what a DVD player does when a regular 4:3 TV displays a 16:9 image as letterbox (throwing away 1 line for every 3 that kept to maintain geometry).

The new EDTV category was placed by the CEA between the original SDTV and HDTV standards, but instead of putting those 4:3 810i sets on that EDTV category the CEA did the following:

a) The 480p sets were promoted from SDTV to the EDTV level, and

b) The 810i (non-HDTV) 4:3 DTV sets were promoted to the group of fully capable HDTV sets (720p or 1080i). With time, manufacturers of 4:3 DTV sets gradually designed those to adjust their scanning raster so they could show all the 1080i lines of incoming signal closer together, all within the displayed 16:9 image; in those TVs the black bars are dead space, the TV is not using vertical resolution lines for the black bars (as opposed to the 810i style). It is recommended that consumers verify how a 4:3 DTV handles 16:9 images before making a purchase.

1080i: HDTV format of 1080 interlaced visible lines of 1920 total pixels each in 16:9 aspect ratio. 1080i is per frame (540 lines x two fields) at 30 fps, and the HD format is commonly used since 1998. See DTV.

1080p: HDTV format of 1080 progressive visible lines of 1920 total pixels each in 16:9 aspect ratio. 1080p is per frame at either 24fps or 30 fps. 1080p/60fps is not one of the 18 ATSC formats but new displays introduced since 2005 are able to display in that format. 1080p/24fps should be ideal for the transfer and broadcast of 24 fps film-based material, but it is not used at the present broadcasting. However, should it be used, objectionable flicker would require the 1080p/24fps to be converted to either progressive 1080p/60 fps or interlaced 1080i/30fps (60 fields per second).

If the signal were to be converted to the higher 1080p/60fps, it would also require a CRT based video projector with a fast raster (67.5kHz, double the 33.75kHz of 1080i/30fps) to be able to synchronize to the signal and display it as 60pfs. The same (fast raster) requirement would apply if the 1080p/60fps were obtained from line doubling a 1080i/30fps broadcast program using a scaler/line doubler processor. Some fixed pixel displays released on the first generation/s of 1080p HDTVs capable of displaying 1080x1920 are not actually able to 'accept' a 1080p/60fps signal from an external source. In 2006, such source was introduced, Blu-ray Hi-Def DVD.

2-3 Pulldown (also mentioned as 3-2 pulldown): Technique used to display/transfer film based content to video. Film is shot at a rate of 24 frames per second, when projecting it on a motion picture cinema theater screen any visible flicker is minimized by opening the film shooter of the film projector twice for each frame, so viewers actually see 48 frames per second.

Interlaced video systems display at 30 frames per second (in 60 interlaced fields for 480i NTSC or 1080i HDTV). Simply transferring each of the 24 film frames onto one video frame would result in a video version of the film running about 25 % faster than intended, this is solved by repeating some of the images to restore the proper speed of the film when viewed as video. Telecine machines are used to transfer film to video to produce masters.

Although DVD is a NTSC interlaced video media (480i 60 fields x second), frame content that originates from film is actually stored as 48 fields rather than 60 fields to save space. The original 24 frames of the film source can easily be reconstructed

from the 48 fields by assembling a frame from each pair of fields that came from the same original film frame, without any motion between them (motion the interlaced video has between fields). In order to help on the identification of film source material for its frame reconstruction, a flag is usually inserted (but not always) within the MPEG-2 data stream to indicate that the content is sourced from film and has that frame structure cadence.

If the flag is used, or if the playback device (DVD player, HDTV) detects the 24 fps film frame cadence automatically, it instructs the internal circuitry (when suited with that) to perform a 2-3 pull-down processing to repeat some of the 48 fields to construct a 60 fields video sequence 'in real time', so a video display device can synchronize and display it properly at 60i.

Content originating from 60i video cameras is stored as is on the DVD and does not require this playback technique because all the 60 fields are already within the signal. Additionally, a deinterlacing technique is used to convert the 60 interlaced fields x second video to 60 frames x second for the progressive outputs of the player (and the display device to show it as a progressive image).

The above also applies to 1080i HD resolution images sourced from 24 fps film, by applying the same technique, the film sourced HD image can be converted to 60 fields x second for 1080i sets, or 60 frames x second for progressive displays.

A/D (Analog-To-Digital Converter): Electronic device that converts analog signals to digital. A D/A is also a similar device that performs the reverse function.

AC Line Conditioner/Surge Protector: Equipment that performs filtering of power-line noise/interferences on AC (alternate current), and protects the connected audio/video components from voltage surges and spikes. Some line conditioners are designed with separate sections to connect digital or analog equipment in two groups; the design claims that such separation blocks the feedback of digital equipment from interfering with analog equipment.

Active Lines: Visible lines of the horizontal scanning (on NTSC is 480i of 525i, on HDTV is 1080i of 1125i). Blanking and vertical sync signals are within the non-visible lines.

Active Subwoofer: Loudspeaker constructed to reproduce only low frequencies, with a power amplifier that is usually built within the speaker cabinet. Some subwoofers are 'passive', which means that the subwoofer requires a separate amplifier to drive the loudspeaker.

AES/EBU Interface: Connectivity standard for professional use established by the "Audio Engineering Society" and the "European Broadcasting Union" for digital audio transmission between equipment components. AES/EBU is carried on a balanced line terminated with three-pin XLR connectors. Sony/Philips' S/P DIF is the consumer adaptation of this standard.

Aliasing: (also called as flicker) Effect of a CRT electron gun drawing the scanning lines too slow, which gives time for the phosphors to fade.

Alternate Scanning: (also known as Interlace: i) Technique that displays a full frame of a picture by showing two different fields containing only half of the video information (such as 480i, 1080i).

Analog: (same as analogue) Continuous movement that takes time to change from one position to another. Standard analog audio and video signals have an infinite number of levels between their highest and lowest value, as opposed to digital that represent changes as only two steps ('on' or 'off', or binary's 'one' or 'zero'). Analog signals are stored magnetically, optical (films), and frequency modulated (Laserdiscs and VHS-HiFi).

Anamorphic: (also specified as Widescreen video 'enhanced for 16:9 televisions') Technique that improves the vertical resolution of widescreen video (number of horizontal lines in the vertical direction). The technique horizontally squeezes a wider 1.78:1 aspect ratio (16:9) image to a 1.33:1 (4:3) image, making objects look thin and tall, so when the image is unsqueezed by the display, the original widescreen geometry of the image is restored without reducing the vertical resolution lines.

This results in a gaining of 33% of vertical resolution compared to letterboxing with black bars (letterboxing takes away actual image content lines to show as black). In other words, a 16:9 image of 480i scanning lines would be shown with all its 480 lines, not as 360 of the letterboxed version (which discards 120 lines of image content to create top/bottom black bars so a regular 4:3 TV can show the image as widescreen).

ANSI Lumens: Method of measuring brightness by which the display device is divided into nine rectangles and light is measured from the center of each rectangle, then averaged among the nine and expressed as lux (lumen/square meter), which is then multiplied by the number of square meters of the image at the plane of meter reading. The result is the light output specification expressed in lumens.

Aspect Ratio: The ratio between the width and height of the video image. Standard NTSC television has a 4:3 (1.33:1) aspect ratio, which is similar to the Academy standard for films before the 1950's, almost a square box shape. Widescreen screens are rectangular with a 16:9 aspect ratio (1.78:1); some widescreen display panels are only 15:9.

Widescreen sets are offered to the consumer in several flavors: front projection, rear projection, direct-view TVs, LCD TVs, and Plasma TVs. Some film aspect ratios are 1.85:1, anamorphic scope 2.35:1 or 2.40:1, and 65mm (70mm) from 2.05:1 to 2.21:1. Images from those wider aspect ratios are fitted within the 16:9 (1.78:1) HDTV image as a wider rectangle with top/bottom black bars (that use some vertical resolution lines of the 1080i or 480p DVD).

ATSC: Advanced Television Systems Committee, the federal committee that selected the new DTV standard, which the US adopted on December 24, 1996 except for the full application of the 18 video formats described on the ATSC table III.

Automatic Convergence: Automatic alignment of red, blue and green color images.

A-VSB - Advanced-Vestigial Side-Band: A-VSB is a DTV broadcast system for mobile purposes proposed to the ATSC in December 2005. During 2006 Sinclair Broadcast Group, Samsung Electronics, and transmitter manufacturer Rohde & Schwarz, joined efforts to successfully test DTV mobile reception at highway speeds.

At CES 2007, A-VSB was demoed, and expected to be included in the Advanced Television Systems Committee (ATSC) digital-TV standard by 1H07, and is backward compatible with 8-VSB the current DTV terrestrial system.

A-VSB, was previously simulated at NAB in April 2006, using forward-error-correction (FEC) "turbo-coding" for difficult signal environments, which used about one fifth of the transmitted bits for the actual video, the rest was to provide robustness so the signal is tuned well by the receiving device.

1.5 megabits per second (Mbps) of transmitted signal would have only 375 kbps of actual video. That number of bits is considered sufficient for small devices such as cellphones and PDAs.

The use of Single Frequency Network (SFN) within A-VSB can improve broadcast quality with higher uniform signal strength throughout a service area, even in locations that normally would have their signals interfered with by obstacles such as hills or buildings.

A broadcaster adds a specified Supplementary Reference Sequence (SRS) to the transmitted signal and A-VSB receivers can use the SRS in order to remain "locked in" to the transmission. This helps maintain reception of the main signal and extra 'turbo' signal(s) even when interference would normally disrupt a signal, like when the signal is reflected from moving objects near the receiver. A-VSB also enables the receiver to stay 'locked on' to the signal when the receiver itself is moving, such as when someone is walking with their portable TV.

Please consult the "DTV Standards" section of the HDTV Technology Review Report for 2007 for more information.

Bandwidth: Range of frequencies that equipment for radio, TV, audio, and video operate and let pass-thru. The wider the bandwidth, the better the audio, or video quality. The higher the bandwidth, the better the performance of the equipment. In a digital circuit, bandwidth is measured as bits per second.

Baseband: Prime signal that is not modulated onto a carrier signal, but rather has its own path (composite, component, etc).

Bi-directional: Devices and ports that can let signals pass in both directions (such as RS-232, IEEE1394).

Black Level: (also known as brightness) Level of light produced on a video screen when it emits no light at all (screen black), the color NTSC system places the absolute black level at +7.5 IRE (unit of video defined by the Institute of Radio Engineers), a level that is higher than when the television was black and white, which set the absolute black level as 0 volts DC. The level was raised because B&W transmitters at that time could not handle a color signal with black level at zero volts.

Blooming: Effect that occurs on CRT images when the light hitting the screen is too high, because of excessive brightness or contrast, overdriving the phosphors (in CRTs) in a way that edges of images appear to exceed their boundaries dispersing the light to adjacent areas.

BNC: Professional type of connector with a cylindrical shape with pins that lock into place.

Brightness: (also known as black level) Intensity of light produced on a video screen, regardless of color.

Burn-in: Term given to the permanent damage on a video display caused when a fixed image has been shown for too long. CRT and PDP plasma panels are prone to burn-in; LCD and DLP chip-based displays are not. To reduce the risk of burn-in, some display devices shift the entire image just a few pixels at intervals, in a way that is not noticed by the viewer.

Usually manufacturers deliver displays with the contrast setting to its highest to increase the appeal of TV sets that stand out on fluorescent lighted showrooms. However, when you own the set it is always recommended keeping the contrast levels as low as possible until the display is properly calibrated, and to use stretching modes in 16:9 displays when viewing 4:3 images (to avoid long viewing with dark pillar bars).

Ceiling Surround channel/speaker: Audio format that uses a ceiling (height) surround channel/speaker decoded from the center front and center back channels, using an algorithm similar to what Dolby Pro Logic uses when extracting and steering to the center front the signal decoded from L and R fronts. One war movie already explored that format.

In the late seventies a similar technology was developed by ADS, Model 10 Acoustic Dimension Synthesizer, a comprehensive digital time-delay processor (and expensive at that time, almost \$1000), the unit decoded a ceiling and center back surround channels/speakers in addition to the side/rear surrounds. After almost 25 years, the ceiling and back surround approach 'reinvents' itself.

CRT (Cathode Ray Tube): Vacuum tube containing an electron gun that drives an electron beam that rapidly hit a phosphor-coated screen and produce video images.

Center Channel: Channel that primarily carries the dialogue from a movie soundtrack, but also contains a substantial portion of other non-dialogue sounds. The center channel also helps maintain the front sound imaging for off-center viewers. Center channel speakers are magnetically shielded.

The use of TV's small speakers (and small TV amps) as alternative for a missing center channel is not recommended as a permanent home-theater setup. The dialog and much of the sound of a movie comes from the center channel, some have estimated it in the order of 60% of the movie soundtrack.

When using the TV's small amp/speakers in a home theater, the speaker's loudness capacity would be exceeded much earlier than the external L/R speakers/amp (assuming that it is larger than the TV audio, as typically is the case). The effect could be worsened if the system does not have a subwoofer to redirect low

frequencies from a small center and surrounds. The distortion on the center channel would affect the clarity of the dialog over loud passages.

Additionally, sounds that are panning side-to-side would have different timbre while switching among speakers (from left to center to right) accompanying the video movement in that direction. Voices of people walking side-to-side will change their tone as they enter the TV's center speaker and as they depart from it, reason by which it is recommended for the center speaker to be of similar type and timbre than the L/R, and be driven by similar amplification as well.

Center Channel Input: Having this input in the DTV allows for the use of the internal speakers to reproduce the sound of the center channel in the home theater set-up. If the TV center channel input is line-level (RCA type), it can receive the center channel signal already decoded by an external surround processor, and use the TV set's internal amplifier to drive the internal speakers of the TV.

If the center-channel input of the TV is speaker-level, it can receive a speaker cable carrying an amplified center channel signal from an A/V Receiver or separate amplifier, bypassing the TV's internal amp. This may be useful if your audio/video system has insufficient space to place a center channel speaker, or you might want to start your surround system at a reduced cost. However, as mentioned in the Center Channel description, this approach should not be permanent.

Chroma: Sometimes called 'Hue', is the term used to characterize color information, such as hue and saturation (not black, gray and white). Interference of chroma can be seen as rainbow images and color transition dots, caused by the interaction between the chrominance and luminance components of a composite video signal.

Circle Surround: Multi-channel surround effect produced from two channel sources by using ambient information stored in a stereo recording, a stereo recording encoded for surround, and recordings specifically encoded in Circle Surround. The surround sound information sent to the surround speakers is stereo, as opposed to the monaural approach of Dolby Pro Logic. Circle Surround creates a believable front soundstage, apportioning the stereo signal more comfortably across the three front channels; this makes the system appealing for music listening.

Color Fringing: Artificial outlines surrounding the edges of colored objects on the video image.

Color Temperature: The correct color temperature of a video display should be 6500 degrees Kelvin, and expresses the color quality of a light source, which is bluer when the Kelvin measurement is high, and reddish when is low.

Comb Filter: This filter separates the luminance and chrominance from the composite video signal, improving, resolution, picture quality, and reducing objectionable color patterns. Low-to-mid-line sets utilize a glass comb filter. Higher-end sets utilize a CCD or digital comb filter, which greatly enhances resolution. The highest quality comb filters are 3D-Y/C digital comb filters, and may be motion-adaptive.

Component Video: Analog component video connections used typically for DVD players/recorders, HD-STB/PVRs, audio/video receivers, video switchers, D-VHS VCRs, and HDTVs are:

a) 3-wire 75 ohm coax analog YPbPr (YCbCr is actually 'digital' component video, and the nomenclature has been incorrectly used abroad for analog connections in consumer equipment), and

b) 5-wire RGB BNC or VGA 15 pin D-sub, with the horizontal and vertical sync signals separated from the other 3 signals. Component video connections do not carry audio, for which separate audio connectors are required, such as digital coaxial and optical (Toslink). Component video offers higher quality performance than composite and even S-video, it bypasses the composite en/decoding process, and color carrier frequency.

Composite Video: NTSC standard video connection (typically a yellow jack/plug) for the passage of an interlaced video signal that has luminance (black and white information), chrominance (color), sync (horizontal and vertical), blanking, and color burst signals, all in one wire. The standard has been used also in VHS and laserdisc equipment. Regardless of the type of connection (component, composite, S-video) the use of gold plated jacks/plugs is known to offer better connectivity between them.

Contrast: Range between the maximum and minimum values of brightness; contrast ratio (CR) is a measurement obtained from the division of both. The specification came from the same panel of experts that established the ANSI lumens as the measurement of brightness in 1992 (under the American National Standards Association). A 'perceived' CR measured from an image as viewed would differ from the CR measured at the lens of the projection device (FPTV), and would differ from the CR measured at the screen point.

Convergence: Alignment of the red, green, and blue CRT guns on a projected display device (RPTV or FPTV). Using the convergence controls of the TV, the three colors should overlap and display a white line on the crosshatch test pattern over the entire surface of the image. Display devices using fixed pixel arrays (such as DLP DMD chips) do not require convergence adjustments.

D/A: Digital to analog converter (the inverse conversion is also mentioned as A/D).

D-Sub: Name associated with the VGA connection with 15 pins for RGBHV signals.

DBS (Direct Broadcast Satellite): Satellite system that distributes signals from the satellite to the individual receivers, such as DirecTV, Dish Network, and Voom.

DCDi Processing: Created by Faroudja, the DCDi technique is an additional improvement/upgrade to the 2-3 pull-down technique. It stands for Directional Correlational Deinterlacing, which according to Faroudja, provides for error-free deinterlacing of video originated sources such as sporting events. Reportedly, DCDi produces smooth, natural images by eliminating the jagged edges than can be seen on moving angled lines in video.

Decibel (dB): (One-tenth of a Bel, named after Alexander Graham Bell) Logarithmic ratio used to measure power, sound pressure level, or voltage. A 3dB

loss/increase is considered an attenuation/augmentation of half/double of its original value; zero dB is the threshold of hearing; 120dB is the threshold of pain.

Decorrelation: Technique used in THX processors for rear speakers to create an ambient DSP sound field similar in spaciousness and depth as a commercial theater.

Definition: Fidelity of the reproduction of a video picture, affected by resolution.

Deinterlacing: (or re-interleaving) Technique that involves assembling pairs of interlaced fields into one progressive frame (1/60 of a second long), and showing it twice, over the same amount of time as two fields. The need for 60 flashes on the screen each second stems from a biological property called the Flicker Fusion Frequency, whereby the human brain needs to see a minimum number of single image flashes in a second to see motion without seeing flicker. See progressive scan below.

Digital Audio Inputs/Outputs: Audio jacks that can be either coaxial (RCA jack) or optical (Toslink) and allow for the passage of multi-channel digital audio signals over a single connection. There are other digital audio connections for multi-channel audio such as IEEE1394 (FireWire) used in some proprietary links between DVD players/Receivers/Processors, or the audio portion of HDMI. Digital connections are prone to less noise and interference than analog audio connections by keeping the signal in the digital domain.

DLP: DLP stands for Digital Light Processing. DLP projectors and rear projection televisions provide premium quality images with excellent black levels without the use of a CRT (Cathode Ray Tube). These projectors use a Digital Micro-mirror Device (DMD) to create images that are enlarged to fill the screen. The DMD chip has upwards of 1.3 million tiny mirrors to resolve 720x1280 HD resolution images.

In January 2004, the xHD3 DMD chip was introduced by Texas Instruments (TI, the manufacturer of DLP DMDs) that claimed having resolution enough to resolve 1080x1920 HD images, although using a 1080x960 DMD chip (half of the mirrors) and using a technique named wobulation. In 2005, TI announced the release on a true 1080x1920 DMD chip for front projectors, and new projectors using the technology introduced at CES 2006. Since DLP is a reflective technology, DLP will typically have higher ANSI lumens and Contrast Ratios than LCD. A color wheel is employed to help create a full palette of colors on one-chip projection implementations, which can produce a "rainbow" viewing effect for some people; three-chip implementation does not need a color wheel to show all the range of colors.

DNIe: Samsung's proprietary name for their video enhancement technology "Digital Natural Image" enhancement.

Dolby Digital 5.1 Surround: Multi-channel perceptual encoding scheme. Initially, Dolby's new surround system was called AC-3 (for audio coder 3). It was introduced in movie theaters in June 1992 as Dolby Stereo Digital (or Dolby SR). Dolby Surround is a single-band-limited surround channel with a range of 100 Hz to 7,000 Hz. Dolby Digital, on the other hand, offers a full dynamic range on five discrete main channels L, C, R, Ls, and Rs (20 Hz - 20,000 Hz), plus a separate .1 channel for Low Frequency Effects (LFE) intended to be reproduced by a subwoofer. The surround channels are in stereo (as opposed to mono with Dolby Pro Logic).

This format has been adopted as the audio standard for DTV signals. Perceptual encoding seeks to eliminate the data humans cannot hear, while maintaining all the information humans can hear, and was designed to encode multi-channel digital audio. It divides the audio spectrum of each channel into narrow frequency bands that correlate closely to the frequency selectivity of human hearing allowing coding noise to be very sharply filtered taking advantage of the psycho-acoustic phenomenon known as auditory masking. Coding noise stays close in frequency to the audio signal being coded. This effectively masks the noise.

AC-3 uses a "shared bit-pool" arrangement plus human auditory masking to make use of transmitted data as efficiently as possible, and allows multi-channel surround sound to be encoded at a lower bit rate than required by just one channel on a CD. Dolby Digital can process a 20-bit dynamic range digital audio signal over a frequency range of 20 Hz to 20,000 Hz +/- 0.5dB (LFE bass channel: 20 - 120 Hz +/- 0.5dB) with sampling rates of 32, 44.1 and 48 kHz with a typical data rate of 384 kbps (versus 1,411 kbps for DTS) with a compression rate of 12:1.

The AC-3 algorithm was designed by Dolby to faithfully reproduce film and music based programs with interference-free discrete channels, not folded or matrixed like Pro Logic; whatever the director wanted to be heard from a specific area was the only thing that would be heard from that area. Dolby Digital is ported out of a DVD player or HD-STB via its digital coaxial or optical output and fed directly into the digital coax or optical jack of a Dolby Digital decoder/processor or receiver (with built-in DD decoder).

A decoder/processor has six separate analog audio outputs, one for each discrete channel of the 5.1 Dolby Digital, five to be amplified by a separate power amp, .1 LFE to be amplified by an active subwoofer. Dolby has enhanced the basic 5.1 format with EX (adding a matrixed back surround channel extracted from Ls/Rs as Pro Logic extracts the Center channel, and Dolby Digital Plus, a new format to facilitate broadcasters with a more efficient compression method for the DD audio in DTV transmission (more on both formats below).

Dolby Digital Plus: A powerful, flexible codec based upon Core Dolby Digital technologies. For broadcasters, it provides higher efficiency coding at lower bit rates. For the new blue laser Hi-Def DVD formats, it provides more channels, extended bit rates and higher quality.

The Dolby Digital Plus format was announced in April 2004 at NAB. Dolby Digital Plus enables broadcasters to transmit 5.1 at 50% (192 kbps) data rate of regular Dolby Digital (384 kbps). Compatibility with all existing Dolby Digital consumer decoders is ensured, as the Dolby Digital Plus signal will be upconverted to a standard 640 kbps Dolby Digital Plus output in the set top box (a set top box that performs the upconversion would be needed).

The format supports multiple languages in a single bit-stream, and was selected by the Advanced Television Systems Committee (ATSC) as the standard for future robust broadcast applications, and as an option for multichannel audio delivered by the Digital Video Broadcasting (DVB) Project for satellite and cable TV.

Dolby Digital Plus was also announced as being capable of a higher-bit rate enhancement compared to Dolby's existing AC-3 (Dolby Digital) lossy audio

compression format. Dolby Digital Plus format supports new levels of quality data rates as high as 6 Mbps on 7.1 channels, with a bit-rate performance of at least 3 Mbps on HD DVD and up to 4.7 Mbps on Blu-ray disc.

According to Silicon Image, although the HDMI transport is able to handle 18Mbps, Dolby Digital Plus has no ability to carry uncompressed audio nor can it be operated in a lossless way. Check the Multi-channel Audio for HD section of the H/DTV Technology Review report for applicability and connectivity details.

Dolby worked closely with Silicon Image to ensure transmission of Dolby Digital Plus signals on HDMI v. 1.3, earlier versions of HDMI are not capable to transmit this format. Those protocols and specifications were finalized by mid-2006.

Dolby Digital Plus is a mandatory audio format in HD DVD players and an optional feature in Blu-Ray players.

Dolby Digital Surround EX: Format of 6.1 multi-channel playback that provides a third surround channel (back) on Dolby Digital movie soundtracks encoded onto the left and right surround channels of 5.1 soundtracks. The format can be decoded by suited A/V receivers and Dolby decoders for playback over surround speakers located behind the seating area, while the left and right surround channels are reproduced by surround speakers to the sides.

To maintain compatibility, no information is lost when the film is played in conventional 5.1. The benefits of Dolby Digital Surround EX include more realistic flyover and fly-around effects, a more stable image for atmospheres and music, and a more consistent surround effect. No additional effect tracks are needed; the mixer directs the available sounds to the appropriate channels for greater directional precision.

Because the extra surround information is carried on the left and right surround channels, Dolby Digital Surround EX encoded soundtracks are still regarded as 5.1 soundtracks, although with respect to home playback, the terms 5.1, 6.1, and 7.1 mean that there are five, six, or seven main speakers, plus a subwoofer that still reproduces the LFE channel recorded on 5.1 soundtracks, plus any bass the main speakers cannot handle.

A 5.1-channel soundtrack can also be played on a 6.1- or a 7.1-speaker system, the two surround signals on the 5.1 soundtrack are spread across the three or four surround speakers by a Dolby Digital EX decoder, a THX Surround EX decoder, or other proprietary methods provided in home theater equipment by various manufacturers.

Dolby Pro Logic: Matrixed surround system with four channels of information (Left, Center, Right, and Surround) that are folded into two channels and encoded onto the L/R channels. The Pro Logic processor, in turn, extracts those four channels from the two encoded channels, and steers or directs them to the appropriate speakers, e.g. dialogue to the center channel and mono effects to the rear.

Under this scheme, the rear surround channel mono signal is divided over two speakers, which gives it more coverage. The rear channel information is derived by the simple formula of L-R with added reverb to give it a more natural like sound.

The Pro Logic format concept helped originate the newer Dolby Pro Logic II, and IIX as follows.

Dolby Pro Logic II: Format that creates a 5.1 surround sound field from a two-channel stereo program material, whether or not it has been specifically Dolby Surround encoded. Encoded material, such as movie soundtracks, sounds more like Dolby Digital 5.1, while unencoded stereo material such as music CDs, sounds like a wider effect and more involving sound field. Pro Logic II provides two full-range surround channels, as opposed to Pro Logic's single, limited-bandwidth surround channel.

Dolby Pro Logic IIX: Format that works with 5.1 audio as well as two-channel material, producing up to 7.1 channels, by decoding center back and side surround channels from the left/right surround channels of Pro Logic II and 5.1 audio. Pro Logic IIX includes center channel width control and panorama mode, as well as music, movie and games modes. Dolby is positioning this format as an expansion of 5.1 audio with the option to extend it to 7.1 surround.

Dolby TrueHD: Introduced in September 2005, Dolby TrueHD can support up to 14 discrete of lossless 24-bit/96 kHz audio channels at bit rates as high as 18Mbps. HD DVD and Blu-ray disc standards currently limit their maximum number of audio channels to eight. Check the Multi-channel Audio for HD section of the H/DTV Technology Review report for applicability and connectivity details.

Dolby TrueHD™ builds upon the proven foundation of MLP Lossless™ by incorporating higher bit rates, additional channels, enhanced stereo mix support, and extensive metadata functionality, including dynamic range control and dialogue normalization.

Dolby TrueHD is 100% lossless audio, delivering audio playback performances in the home that are bit-for-bit identical to studio masters, designed for next generation HD DVD and Blu-ray formats, and selected as mandatory (only 2 channel required) for HD DVD players and optional for Blu-ray players.

Dolby Volume: At CES 2007, Dolby announced a new feature called Dolby Volume, developed to level out sound differences in TV programming without the typical "pumping" and artifacts introduced by other technologies.

As said by Dolby, " some programmers use compression techniques that allow them to boost the volume of their material without exceeding the peak limits set by Government. Some operators of TV channels also make different decisions about volume levels or fail to operate equipment properly".

Dolby modeled how the human ear works, responding to the energy of sound waves, the pitch, and the tone quality of sounds, and applied formulas to reduce the volume differences between programs and commercials without losing the needed sounds.

DTCP (Digital Transmission Content Protection): Scheme created for the purpose of copy protection of digital video transmitted over the 1394 connection. DTCP is also known as 5c for the five companies that participated on the standard (Sony, Toshiba, Intel, Hitachi, and Matsushita). The format allows for copy freely, once, and never, as options of protection.

DTS (Digital Theater Sound): DTS originated as a digital 5.1 surround scheme developed for the movies by MCA/Universal and Steven Spielberg. DTS was first employed in Spielberg's *Jurassic Park* in the summer of 1993. While it has not been around as long as Dolby, hundreds of films have been released with DTS encoded surround soundtracks. DTS Coherent Acoustics Coding (CAC) maps discrete 6-channel, 20-bit encoded data onto the 16-bit PCM digital audio stream, which is found on either a laserdisc or compact disc.

DTS' CAC signal is passed via the digital output (either coaxial or optical) present on many laserdisc, CD, and DVD players. While Dolby Digital uses perceptual coding to reduce the bit rate, DTS uses compression technology and the CAC algorithm with a higher bit rate than DD. The compression ratio is 3.75:1 of a 20-bit PCM digital audio stream with eight times over-sampling rate. It has a typical data rate of 1,411 kb/s (as opposed to 384 kbps of Dolby Digital). It performs transparently by coding 20-bit data at a bit-rate lower than 16-bit linear PCM.

The Coherent Acoustic Coding algorithm is a scaleable digital coding methodology, which operates on a multirate filterbank. It has been designed to filter the audio signal into frequency bands, which match the critical perceptual bands of the human ear. Within each frequency band, the signals are re-quantified at a variable resolution. This is determined by the available bit-rate and an analysis of the long/short periodicity of the audio signal in each frequency band.

According to DTS, this allows an efficient sharing of the limited number of quantization bits without any transient pre-echo distortion. Furthermore, by coding the spectral analysis to extend and include all channels, the re-quantization routines are fed from a common bit-pool. DTS feels that this optimizes the coding performance and audio quality of each individual channel in a multi-channel format delivering a full-bandwidth for each.

Essentially, this allows six channels of transparent quality 24-bit recorded material at 48 kHz with less digital compression. While Dolby Digital uses a different approach of providing multi-channel sound with low bit-rates, the results might seem similar to the untrained ear.

Although the DTV standard does not include DTS as an audio alternative (only Dolby Digital), DTS was selected as a mandatory format for HD-DVD and Blu-ray players (in addition to Dolby Digital).

DTS Formats Extensions:

- XLL Extension for Lossless Audio coding, a bit-for-bit recreation of the original master recording using variable bit rate encoding as high as 24.5 Mbps for Blu-ray Disc and 18.0 Mbps for HD DVD formats.
- XXCH Extension for additional channels, beyond 6.1.
- XBR Extension for higher constant data rates, up to 6.0 Mbps for Blu-ray Disc and 3.0 Mbps for HD DVD formats.
- XSA Extension for Secondary Audio/Sub Audio Content, also known as DTS-HD LBR (low bit rate).

DTS-HD Master Audio™:

(Disclaimer: DTS graph shown under permission)

The format is bit-for-bit identical to the studio master using high variable bit rates to provide up to 7.1 audio channels at 96k sampling frequency / 24-bit word resolution, as well as containing the DTS 1.5 Mbps core soundtrack within the bit stream to be backward compatible with legacy DTS-enabled audio devices, and deliver up to 6.1 channels of sound. The format can also handle 192 kHz / 24-bit word resolution.

DTS-HD is a 100% lossless format using a set of extensions to the coherent acoustics audio coding system, comprised of DTS Digital Surround, DTS-ES, and DTS 96/24, which allows the format to down-mix to 5.1 and two-channel, or deliver audio quality at bit rates extending from DTS Digital Surround to 7.1 DTS-HD channels, using a single stream up to 24.5 Mbps (18 Mbps for HD DVD).

When the format was created, DTS announced that the original DTS++ would be capable of higher bit rates. In October 2004, the DTS++ name was changed to DTS-HD. In December 2005, DTS announced their demonstration of a 24.5 Mbps extension of the format, DTS-HD Master Audio, 100% lossless and bit-for-bit identical to the studio master. Later, the HD audio format below the Master Audio level was called DTS-HD High Resolution Audio, capable of up to 6 Mbps resolution.

The format was approved as an option for HD DVD and Blu-ray. HD DVD can handle up to a maximum of 18 Mbps, and by Blu-ray up to a maximum of 24.5 Mbps.

DTS-HD High Resolution Audio™: The format delivers up to 7.1 channels of sound said to be “virtually indistinguishable from the original soundtrack” using high constant bit rates and 96k sampling frequency / 24-bit depth resolution. The format offers an alternative for high quality audio when disc space for Master Audio is not sufficient for that higher format.

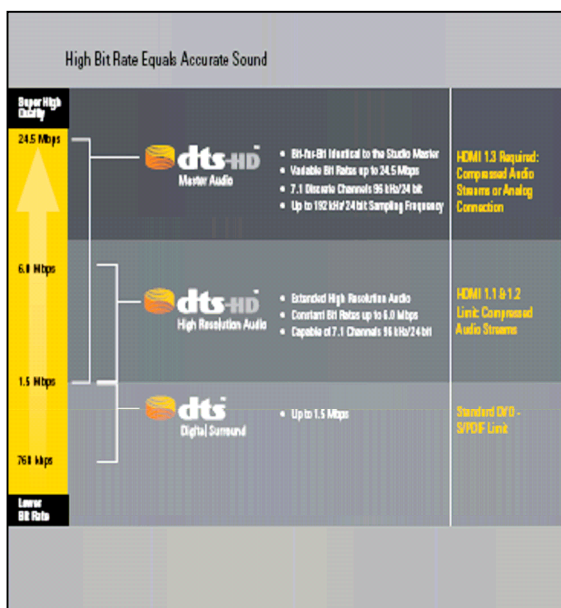
As with Master Audio, the audio format also contains the DTS 1.5 Mbps core for backward compatibility with legacy DTS-enabled audio devices and deliver of up to 6.1 channels of sound.

The format was approved as an option for HD DVD and Blu-ray. HD DVD can handle up to a maximum of 3 Mbps, and by Blu-ray up to a maximum of 6 Mbps.

DTS-HD LBR (Low Bit Rate Audio):

A) Blu-ray Secondary Audio

Multi-channel sound “Secondary Audio” is a scalable format using low-bit rate audio, an optional feature on Blu-ray Disc, designed for network streaming, broadcast and Internet applications. Data rates range from 24 kbps per



channel, at sampling rates of 48 kHz for Blu-ray Disc, and 44.1 kHz and 48 kHz for HD DVD, with a resolution up to 24-bits.

B) HD DVD DTS Sub Audio

An optional format for HD DVD discs, considered of high quality using low bit rate audio; designed for network streaming, broadcast and Internet applications. Is a two-channel (2.0) scalable format, using from 64 to 192 kbps data rates, and sampling rates from 8 kHz to 96 kHz with 24-bits resolution.

DTV (Digital Television): The DTV standard is composed of 18 digital formats grouped into two levels of quality, as approved by the ATSC (American Television Systems Committee) in 1995:

1) SD: Standard definition, 480i/p visible vertical resolution lines, with up to 704 total pixels of horizontal resolution, aspect ratio in 4x3 or widescreen 16x9, and

2) HD: High definition, 720p and 1080i/p visible vertical resolution lines, with respectively 1280 and 1920 total pixels of horizontal resolution, in widescreen 16x9 aspect ratio.

The FCC actually let manufacturers implement compatible DTV tuners with the ability to receive/decode the formats without imposing TVs to display the formats at their original resolutions; the tuners would generally convert the signals to 480p, 720p, and 1080i, to match the native format of most monitors. Later in 2000, the Consumer Electronics Association (CEA) created another level in between SD and HD: ED (enhanced), which promoted the 480p format from SD to ED, among other changes (see 810i).

The current NTSC over-the-air (OTA) TV system is 480i analog (actually 525i with 480i visible lines) and is interlaced. Digital satellite and digital cable are equivalent to digital SD but they are also transmitting some channels in HD. To facilitate the transition broadcasters were given one extra channel slot from the FCC for the simultaneous broadcasting of the analog and digital versions of their programming.

It is a large investment for stations to build a DTV facility with new cameras, equipment, etc. When DTV is fully implemented, broadcasters have to return one of the two channels, analog over-the-air broadcasting will stop, and current TVs, VCRs, Tivos, and any other equipment with analog tuners would stop tuning as well.

The DTV system implementation is mandatory; HDTV is optional. The implementation of DTV was originally planned by 2007, but the deadline has been conditioned to when 85% of the US population can receive DTV signals, discussions were held in 2004 to determine if cable and satellite subscribers should be considered as part of the 85%, cable itself covers about 70% of the US population.

In February 1, 2006, an extension to the deadline was approved, the new date for the discontinuation of analog transmissions is February 17, 2009, and the deadline is not conditioned to a percent of DTV reception by households per market as originally, it is a hard date.

DTV Tuners: The ATSC (Advanced Television Systems Committee) selected 8VSB as the digital television standard for terrestrial (over-the-air) broadcast of HD signals

in the U.S. All integrated DTVs have an 8VSB tuner, DTV monitors do not have one, and they need a separate HD-STB as a tuning device.

In 2002, under a five-year phased-in guidelines mandated by the FCC, over-the-air DTV tuners were required to be added to 50 percent of sets measuring 36 inches and larger by July 1, 2004, and 100 percent by July 1, 2005. After that, 50 percent of sets measuring 25 inches to 35 inches are to add DTV tuners by July 1, 2005, and 100 percent by July 1, 2006. The rest are to conform by July 1, 2007.

On November 2005, the FCC voted for setting the new date as March 1, 2007 for all sizes including those smaller than 13 inches, which received the support from the NAB taking into consideration how important they are in times of emergency, and that they are commonly used without STBs.

The revised mandate has been approved as follows:

Upon approval ≥ 36 inches

Mar 1, 06 for ≥ 25 inches (was July 1, 06)

Mar 1, 07 for ≥ 13 inches (was July 1, 07, although the FCC proposed Dec 31, 06)

Mar 1, 07 for < 13 inches (was not required before)

The mandate does not apply to other small screen video capable devices that do not receive OTA broadcasting, even when they might be used to watch TV shows, such as PDAs, mobile phones, iPods, etc.

The NCTA (National Cable and Telecommunications Association) chose QAM as the HD system for Digital Cable. Many 8VSB-integrated sets also include a cable QAM tuner to receive "in-the-clear" (unscrambled) cable signals, or a QAM tuner with Cable CARD for premium services.

QAM integrated HDTV sets introduced during 2004 have CableCARD tuners but as only unidirectional; in order to receive VOD, impulse PPV, and cable customized electronic program guide, CableCARD tuners have to be bi-directional, which means that owners of 2004 QAM integrated HDTVs w/CableCARDS might still need a second cable tuner (HD-STB) for the bi-directional features.

Dual Antenna Inputs: The existence of these inputs in the TV means that the set can accommodate two antenna sources, e.g. master antenna and cable-box or master antenna/cable-box and satellite receiver. By having dual inputs, antenna sources could be easily switched, rather than using external switching devices.

DVi: Also known as iLink 1394 digital connection for digital video cameras.

DVI (Digital Visual Interface): The DVI 1.0 specification was introduced in April 1999 by the Digital Display Working Group integrated by Silicon Image, Intel, Compaq, Fujitsu, Hewlett-Packard, IBM, and NEC to create a digital connection interface between a PC and a display device. It is a connection with enough bandwidth for uncompressed HD signals.

The 1.0 DVI specification is a point-to-point solution that supports video content but not audio. DVI standard cables have typically a five-meter distance limitation, although with better quality wiring, such as fiber-optic, higher distances are possible.

There are three types of DVI connectors:

DVI-I (integrated), carries a single or dual-link digital signal, with an additional analog signal for legacy devices.

DVI-D (digital) carries digital-only video data to a display.

DVI-A (analog) is available for legacy analog applications to carry analog signals to a CRT monitor or an analog HDTV (claims to be better than VGA).

DVI is being used as a secure connector for the passage of uncompressed digital video signals from HDTV receivers and other digital source devices such as DVD players, keeping all signals in the digital domain.

DVI (or HDMI, its upgraded sibling) is found on most 2004 and after HD equipment and HDTVs. To protect content transmitted over DVI, the High-bandwidth Digital Content Protection (HDCP) scheme was created that provides a secure digital link between source and display, and does not allow for any recording of the digital signal. See HDCP. Additionally, HDMI has been aligned as the successor of DVI (see more below).

DVD Changer: Player capable of playing multiple CDs or DVDs. Changers fall into two categories. Simple changers rotary in type with up to five or six discs fitting into the rotary platter, or Mega-Changers that can hold a library of up to 400-discs within the confines of a single machine. Some brands allow several mega-changers to be tethered together allowing for vast libraries of movies and music videos.

DVD Recordable: There are presently three "re-writable" schemes for recordable DVD: DVD-RAM, DVD-RW, and DVD+RW. Depending on the format, DVD recorders will also record DVD-R or DVD+R ("write-once" recordable DVD) formats, which are reportedly playable on all standard DVD players. Several DVD recorders have been introduced since 2002 that are capable of playing/recording a combination of rewritable formats in one unit.

DVD/VCR Combo: Specialized machine that combines a DVD player with an integrated HiFi VCR into one cabinet. Designed for those users that want to "bridge the gap" from one video generation to another. There is also a TV/VCR or TV/DVD or TV/VCR/DVD Combo, which includes a television.

DVD-Audio: A typical CD is PCM encoded into 16-bit words at a sampling rate of 44,100 per second. DVD-Audio can use a variety of PCM resolutions, from multi-channel 24-bit/96kHz all the way up to 2-channel 24/192. Also included are sampling rates of 48kHz, 88.2 kHz, and 176.4kHz, as well as DTS and Dolby Digital data streams.

For better space utilization, some channels can be encoded with high resolution while others, like the surround, in lower resolution. A single-layer, single-sided DVD holds 4.7GB, enough for 40 minutes of six channels at 24/96. Six-channels of uncompressed 24/96 audio data require 13.8Mbps data speed while the DVD standard allows for up to 9.6 Mbps only, reason for which a lossless form of data compression was needed (Meridian Lossless Packing). MLP reduces storage and transfer-rate requirements by a factor of two without sacrificing quality (unlike "lossy" used on Dolby Digital and DTS).

Dynamic Range: Audio range expressed in dB measured between low-level noise and overload distortion; also defined as the range between the softer and loudest sound passages.

EDTV (Enhanced Definition TV): Additional level of DTV created in late 2000 by the Consumer Electronics Association (CEA) fitted in between the SD and HD levels. ED (Enhanced) is the naming convention to be used for display devices capable of 480p, previously part of the lower SD level.

Enhanced AC-3 Audio Standard: In July 2005, it was announced that the Advanced Television Systems Committee (ATSC) added an enhancement (A52B) to the AC-3 standard currently used for DTV (Nov 94), this was a result of a RFI issued by the ATSC in December 2002, to which Dolby Laboratories responded (E-AC3).

E-AC3 is said to provide improvements regarding the flexibility and performance not only for broadcast but also for cable, satellite, DVD, among others, using new coding, wider range of bit-rates, and number of channels. E-AC-3 is said to be able to be converted to AC-3 to be backward compatible with current decoders.

Enhanced-VSB (E-VSB) Transmission Mode: In October 2005, the ATSC announced the publication of four new candidate standards related to E-VSB, namely the video system characteristics of VC-1 and AVC and how closed captions are to be carried with both, the transport of AVC, and an alternate transport approach for MPEG-2. The candidate standards: CS/TSG-658, CS/TSG-659, CS/TSG-660 and CS/TSG-661 are available at:

http://www.atsc.org/standards/candidate_standards.html

External Speaker Jacks: Connections that allow the attachment of separate speakers directly to a TV for improved sound quality, or the attachment of rear speakers to experience surround. However, the low wattage of the internal television amplifier could become a loudness/performance limitation.

Front Projector: Video display device that is able to project an image on a reflective screen.

Gamma: Exponential function that expresses the non-linearity of the light output of a CRT (relative to voltage). The 'Gamma Correction' control in video monitors compensate for such non-linearity.

Gray-scale: Test pattern with shades of gray from white to black used to measure a monitor's ability to reproduce all the shades in an uniform manner and at the correct color of white (6500 degrees Kelvin). Gray is defined as equal amounts of red, green, and blue; white is the peak level of gray; sunlight is in the area of 5400 degrees Kelvin.

Harmonic Distortion: Distortion caused when audio equipment adds unwanted overtones to an original signal.

HDCP (High-bandwidth Digital Content Protection): Content protection system developed for DVI. The HDCP 1.0 specification was developed by Intel with contributions from Silicon Image in February 2000 to protect DVI outputs from being copied by providing a secure digital link between a video source and a display device. HDCP offers authentication, encryption, and renewability.

The Motion Pictures Association of America (MPAA) endorsed HDCP as the standard for the secure transmission of HD signals over DVI. Since the DVI signal is uncompressed (overwhelming for the digital storage devices of today) and protected by HDCP, HD recording over the DVI connection is not feasible.

HDMI: On December 9, 2002, the seven founders of HDMI (High-Definition Multimedia Interface) announced the 1.0 specification of this connectivity standard, the enhanced, more robust form of DVI. The seven founders are Hitachi, Matsushita, Philips, Silicon Image, Sony, Thomson, and Toshiba.

The standard supports HD uncompressed video, 8-channel digital audio (reportedly up to 192 KHz), and some control signals on a single cable (15 mm, 19 pin), while using less than half the available bandwidth. HDMI has the same video capacity as DVI, or up to five Gbps of bandwidth (single link), double what a HD signal would require, and is backward compatible with DVI by using an adapter, although only for the video signal. The HDMI connector is smaller than DVI. Silicon Image has also announced an HDMI version with a smaller connector suitable for portable equipment, such as video cameras.

The HDMI specification supports 1080p, however there are HDMI transmitter and receiver chips that were developed without using that capability of the specification, either because they were very early releases or they were created that way for equipment that does not need 1080p capabilities, like a 1080i TV. Equipment manufacturers using those chips on otherwise capable 1080p sets could handicap the equipment. The version 1.3 specification planned for release on 1H06 is capable for Dolby TrueHD and DTS HD multichannel audio codecs for new Hi Def DVD players.

HDTV (High Definition TV): Level of DTV quality capable of 720p or 1080i vertical resolution, with a 16:9 aspect ratio and Dolby Digital audio. See DTV.

Horizontal Resolution: Not to be confused with horizontal scanning ('vertical resolution', which is the number of scanning lines of the television systems NTSC 480i and HDTV interlaced 1080i). Horizontal resolution is measured left to right, and has been traditionally specified as the number of transitions (TVL, TV vertical lines, carried forward from the CRT analog age) in the horizontal direction measured up to the point equal to the picture height (75% or $\frac{3}{4}$ of the width of a 4:3 TV, 56% or $\frac{9}{16}$ of the width of a 16:9 TV).

The horizontal resolution of a standard broadcast NTSC television is 340 TVL lines per picture height (450 edge to edge), DVD is 540 TVL (720 edge to edge), laserdisc is 425 TVL (567 edge to edge), and VHS is 240 TVL (333 edge to edge). Regarding HDTV the 'total pixel count edge to edge' for 1080i/p is 1920 horizontal pixels, and for 720p is 1280 horizontal pixels.

In the more modern age of fixed pixel displays such as PDP plasmas, LCD, DLP, LCoS, and DILA, horizontal resolution is generally expressed as the number of pixels measured in the 'complete' horizontal line, edge to edge (not TVL).

IEEE1394: 1394 is the short for IEEE1394. Digital interface conceived by Apple Computer in 1986, and it was called "Fire Wire" for its fast speed of operation. In 1995, the Institute of Electrical and Electronic Engineers (IEEE) adopted the serial

bus as its standard 1394. Sony trademarked their name iLink for their implementation of the 1394 bus as a 4-pin connector.

HD signals are broadcast in compressed MPEG-2 format at approximately 19.4 Mbps. D-VHS VCRs and stand-alone HD-PVRs record MPEG-2 compressed HD signals, but only from a 1394 connection, which receives the digital data stream. HDTV monitors require a separate MPEG-2 decoder to decompress the signal for display, as oppose to DVI that is uncompressed.

To address security issues, a scheme called Digital Transmission Content Protection (DTCP) was developed for 1394 that works with MPEG2 compressed video. Mitsubishi implemented a 1394 network/control called HAVi for the passage of digital compressed signals between DTV equipment.

There are three types of cables used for 1394. A) A 6-conductor type that has two separately shielded twisted pairs for data and two power wires in an overall shielded cable with 6-pin connectors on either side. B) A 4-wire cable that uses two separately shielded data cables without power wires in an overall shielded cable with 4-pin connectors on either end. C) A conductor using either type of cable above, but with a 6-pin connector on one side, and a 4-pin connector on the other side of the cable.

The 4-pin connector is more common on digital video camcorders and other small external devices because of it's small size, while the 6-pin connector is more common on PC's, external hard drives due to it's durability and support for external power for 1394 peripherals.

Interlaced: Technique applied in television by which video images are sent/displayed in two separate fields of lines that are merged together to complete one picture (frame). In the 480i NTSC and DTV formats, the 240 odd lines of one field are merged in an alternating mode with the other 240 even lines of the consecutive field, each field displayed at 1/60 of a second, and completing a frame of two fields in 1/30 of a second, fast enough for the persistence of vision to see them as they are all part of one single frame.

When NTSC was created in the 1940s, this technique was implemented to been able to efficiently fit and send images within the bandwidth transmission constraints. The NTSC system has 525i scanning interlaced lines of which 480i are visible; the same concept was applied to DTV digital 480i and 1080i formats, the 1080i format has actually 1125i lines, 45 of which are not visible.

Interpolation: Technique used in line-doublers to adjust for time differences in interlacing fields, to minimize 'jaggies', and improve overall picture sharpness. Some line doublers also interpolate calculated pixels between pixels on the horizontal line.

Invar: The invar shadow mask, found on direct-view CRT TVs, allows the picture to have more contrast level without risking long-term damage of the shadow mask itself. When the set's contrast is driven too high, a side effect called "blooming" occurs, to counteract this bleeding of colors, some manufacturers include the invar shadow mask, although still running the risk of burning the phosphors in the tube. A properly calibrated set would have the contrast level low enough not to need the invar (and the additional cost associated with it).

ISF (Imaging Science Foundation): Organization dedicated to promote the importance of properly calibrated display devices so they can perform to their full potential (NTSC or DTV). Training, calibration DVDs, and calibration professionals are offered by the organization to help consumers perform the necessary adjustments for their monitors to reach their best performance.

Keystone Effect: Effect that produces a picture that has one edge with a different dimension than the opposite edge, most usually produced by positioning the projector at a pronounced angle relative to the screen. To compensate for the distortion, some projectors have digital keystone corrections (horizontally and vertically), however, the correction could create other image problems. It is recommended to avoid the keystone effect by physically realigning the projector with the screen, so keystone correction adjustments are used as little as possible.

Lambert: Unit that measures the light intensity reflected off an object.

LCD (Liquid Crystal Display): LCD front and rear projectors use LCD panels to create images, which are then enlarged to fill a screen. The LCD panel uses two transparent sheets of polarizing material with a liquid containing rod-shaped crystals between. When a current is applied to pixel areas, those crystals align to create dark images. Panels do not produce color nor emit light; they are often side lit or backlit, and act as shuttles to selectively block off light and create images.

Three black and white panels are used, and the white light from the lamp is separated (via dichroic mirrors) into red, green, and blue beams. These beams are fed through the panels and then recombined to create the full color images. An LCD projector can provide rich colors and a good-quality picture, but some LCD projectors show a "screen door" effect.

LCoS (Liquid Crystal on Silicon): Type of projection HDTV that uses liquid crystals coated onto a silicon chip, which uses a reflective (aluminized) layer. As compared to standard LCD chips, this reflective design increases contrast, and eliminates any dotted "screen door" effect. Since it is a digital display device, LCoS technology also eliminates any chance of image "burn-in."

Lenticular Screen: Screen used in RPTVs with a surface designed to reflect maximum light over horizontal and narrow vertical angles.

Letterbox: Name used to describe the effect of viewing widescreen films or video wider than 1.33:1. To that end, black bars above and below the movie image are added to fill the 4:3 aspect ratio, to maintain the geometry of the original film (the aspect ratio chosen by the movie director). The 'anamorphic' method squeezes the image laterally when storing it, and the DTV monitor unsqueezes it when displaying it, which maximizes vertical resolution.

The letterbox technique wastes vertical resolution (horizontal lines) for the black content of the bars. When the film image is even wider than the 1.78:1 aspect ratio of a 16:9 TV (such as 2.35:1, 1.85:1, etc.) two letterboxing black bars are embedded within the 16:9 image itself, in such case a combination of anamorphic and letterboxing methods are used to minimize the waste of vertical resolution for black bars.

LFE (Low Frequency Effects): '.1' channel in Dolby Digital or DTS 5.1/6.1/7.1. The LFE channel contains low frequency effects in the range of 20-100 Hz intended to be reproduced by a subwoofer.

Line Doubling: Technique that stores in digital memory the horizontal scanning lines of each field of an interlaced video image, and then displays them both together at once, producing a picture that has twice of the original lines, and providing an appearance of improved resolution. HDTV sets typically perform line doubling of 480i NTSC images to display them as 480p.

Line Quadrupling: In addition to applying the line doubling technique, line quadrupling interpolates additional lines in between to fill the image with calculated pixels of information, providing an even better appearance and brightness. Line quadrupling requires a display device with a scanning rate of four times the normally required. Some display devices obtain the quadrupling effect by interpolating additional calculated pixels in the horizontal line (in addition to the doubling of lines). In such case, the display would just need a scanning rate for line doubling speed.

Lossless: Check DVD-Audio.

Lumen: Unit of measure used to express the amount of light emitted by a source (see ANSI Lumens).

Luminance: Signal that represents brightness in a video picture.

Lux: Unit to measure the amount of light per square meter taken at an illuminated surface.

MPEG-2: MPEG stands for the Motion Picture Experts Group. MPEG-2 is a video compression encoding/decoding method used in DVD, DBS satellite, and DTV to reduce the amount of data in the storage/transmission of digital video, by, for example, condensing redundant or repetitive image signals, or eliminating some picture elements.

Multiscan: Feature of some monitors that are able to automatically synchronize their scanning rate to a variety of signal scan-rates. Generally, HDTV monitors are able to synchronize to 480p and 1080i, and sometimes to even 720p.

Multi-Channel Analog Outputs: Set of six analog audio outputs designed to pass DVD-Audio and/or SACD aural information from the player to an A/V Receiver or A/V Processor.

Notch Filter: Filter that helps remove a small part of the signal that contains excess color information. By doing so, it helps eliminate some objectionable color effects from less than desirable signals. However, by utilizing the circuit, there is a slight loss in resolution of picture.

NTSC: National Television Standards Committee. Committee for the US analog color television video standard.

Overscanning: Effect that occurs when parts of an image cannot be viewed because they have been placed beyond the edges of the TV frame. The effect is

caused when the TV scanning lines are adjusted to exceed the boundaries of the screen to hide the ruff edges of the image.

OTA (Over-The-Air DTV tuners): Also known as ATSC tuners. See DTV tuners.

Pan-And-Scan: Technique used to transfer a widescreen movie into a 4:3 format with no black bars; the transfer operator actively searches and selects the 4:3 part of every widescreen image that contains important content in the movie. A 'Full-frame' 4:3 transfer may not always have been made with a Pan-And-Scan technique.

Pixel: The smallest element on a picture. Unit used to convey image/device resolution.

PIP (Picture-in-Picture): PIP allows you to view the active images of two sources simultaneously. For a monitor to perform this feature it requires receiving the images from dual tuners, or external sources that provide the images, or a combination of both.

POD: (Point Of Deployment interface) of the Host Interface License Agreement (PHILA) for cable tuners. Now called CableCARD.

Power Conditioning: Not all power is created equal. For audio/video components to perform to their best the power should be well-balanced and clean of noise and interference, if the utility company does not provide clean power or your audio/video system is sharing electrical circuits with appliances or other devices that can degrade the power quality, it is recommended to install a separate electrical circuit for the audio/video system, and/or the use of an AC line conditioner/surge protector device (refer to the term further above in the Glossary).

Progressive Scan: Video format/technique that presents all of the scanning lines in the screen in one single pass from top to bottom, producing an image that has more resolution and brightness than its interlaced version. The 480p format, for example, requires the double of the transmission bandwidth and twice the monitor scanning raster speed of the 480i version.

Video that originates as 480p/60 fps is able to better follow fast action content producing much better results than 480i/30fps, and it even displays better than 480i line-doubled to 480p/60fps, because the image originates as 480p/60 fps at the camera point. 720p is also considered more suitable to fast action content, such as sports, than the other 1080i HD format.

PVR: Personal Video Recorder (recording on internal hard drive, HDD), also known as DVR. Tivo type of time-shifting device for HD content.

QAM (digital cable tuners): Quadrature Amplitude Modulation. Digital modulation technique that calls for 64 and 256 QAM; using 64 QAM a cable channel that today carries one analog video channel could carry 27 Mbps of information, or enough for multiple video programs; using the 256 QAM, the standard 6 MHz cable channel would carry 40 Mbps. See DTV tuners.

Raster: Rows of dots scanned when producing a video image.

RCA-type Jacks: Standard connection used for analog and digital purposes. Composite video jacks are labeled yellow, and standard audio cables for left (white) and right (red) channels. RCA type jacks are also used for YPbPr component analog, Dolby Digital/DTS digital coaxial audio, Super-Audio/ DVD-Audio analog multi-channel, etc.

Resolution: Capability of a video device to reproduce (or an image to resolve) detail. The term is generally used to express horizontal resolution, as the number of lines/pixels that can be displayed in the horizontal direction (see horizontal resolution).

Response Time: A specification typically associated with LCD panels used to indicate how fast pixels react to changes of light and avoid a blurring effect that typically shows as trails and pixel movement that is not in the original content while displaying fast moving objects on the image.

The measurement is expressed in milliseconds and, depending on the manufacturer, indicates the time it takes a white pixel to show black and back to white again, others express that as gray-to-gray, or just indicate the time it takes to become black from white but not to white again (half of the white-black-white task) which certainly appears as a faster spec to unsuspecting consumers (such as SXR's Sony RPTVs did when introduced with 2.5 ms spec).

Many LCD panels that were 20ms in 2004-5 have gradually been improved to 16, 12, 8, 6, and even 4 ms. The smaller the number the faster the pixel reaction time is and the better the LCD should be in avoiding the blurring effect on fast moving images.

Retrace: Action of moving the electron beam from the end of one scanning line to the beginning of the next one. Usually associated with CRT type of display devices.

RGB: Red, Green, and Blue color signals (chrominance), primary components for color television; the primary colors of light. RGB video can be transmitted as: RGSB (the Green contains the sync signal), RGBHV (sync separate from colors, horizontal and vertical separate), RsGsBs (sync on each of the colors), and RGSB (sync separate from colors). See component video.

RMS (Root Mean Square): Measurement of continuous power output produced by an amp. The higher the RMS number, the cleaner, and louder (without distorting) the sound will be; one of the primary specs to base an amplifier purchase. Peak power ratings show the maximum wattage delivered by an amp during a brief burst during a musical peak.

Saturation: Term that expresses the purity and intensity of a color signal, and the extent by which it is free from white (less white results in more color saturation, less saturation results when adding more white to the color).

Scanning: Action of moving an electron beam horizontally and vertically across the raster in CRT video.

Scan Velocity Modulation (SVM): SVM adjusts the rate of horizontal movement of the beam as it "draws" the scan lines. Dark areas look larger over lighted background; lighted areas appear smaller over dark background. It is generally

recommended to disable SVM on a properly calibrated monitor; one of the first things an ISF calibration job do is to find a way to disable SVM; look for a menu setting that is able to turn off SVM.

SDTV (Standard Definition TV): Lowest level of DTV that originally grouped the 480i and 480p formats together within that category (ATSC table III), see DTV. In late 2000, the CEA promoted the 480p to EDTV, leaving the SD level for just 480i digital.

Shadow Mask: Metal plate on a CRT device that helps the electron beam hit each individual phosphor by using perforated holes. See Invar.

Sharpness: Term to describe apparent focus and edge definition on video. Sharpness should be kept below the point at which extra edges are added to objects in the image.

Spatial Interpolation: Technique that calculates additions/removals of pixels in a digital image using weighted averages of information from adjacent pixels, producing a more transparent result with fewer artifacts. The technique facilitates the re-positioning or re-sizing of digital images.

Spatial Resolution: Number of pixels appearing on the entire video image (matrix of horizontal and vertical resolutions combined).

S/PDIF: Sony/Philips Digital Interface standard for digital audio connections (coaxial or optical TosLink). A consumer version of the AES/EBU digital transmission standard.

Special Picture Tube: Better grade of picture tube, such as either dark tint or dark glass picture tubes, which, by darkening the faceplate, provides greater contrast between black and white, although requiring an increase of brightness levels so that the picture does not appear too dark.

Other advancements include flat square tubes (FST) sometimes called "SuperFlat" or "FSTPerfect", which offers less distortion on the outer edges of the picture. Some manufacturers use special coatings to help cut down on glare and dust build-up giving the appearance of a richer picture, others use a combination of techniques to tweak out the highest performance from their picture tubes.

STB (Set-Top-Box): Also mentioned as HD-STB, Digital set to box to tune DTV via OTA, cable or satellite signals.

Subwoofer: Loudspeaker designed and dedicated to reproduce very low frequencies (bass) from the .1 LFE Dolby Digital or DTS channel, and/or from the bass received from the other channels if their lower frequencies are crossed-over to the sub with a low-pass control. A subwoofer normally looks like a big black box. Since bass is non-directional, it can be placed anywhere in the room. Woofers range in size from about 5-inches to 18-inches in diameter with the majority falling in the 12-inch category.

Some of these enclosures are ported with a hole on the side or the bottom, which helps add a thump to the bass response.

Virtually any mid-line A/V Receiver or above has a subwoofer output jack on the back panel. This will attach directly to the Left input of the sub. If the receiver does not have a separate subwoofer output jack, the left and right speaker outputs of the receiver can be connected into the appropriate left and right jack inputs of the sub, then, the left and right speaker outputs of the sub should be connected to the individual left and right speakers. In such case, the receiver crossover should be set as full range, and the sub's crossover hi-pass control should be set to send only the non-bass frequencies to the L/R speakers.

Verify the menu options of the receiver regarding not using the .1 LFE sub output, and to make sure it has a way to redirect the LFE effects to the main speakers (where the sub is connected). In either set-up, the lowest sounds are directed only to the subwoofer. Subwoofers are either active or passive. 'Active' subwoofers have internal amplifiers, 'Passive' subwoofers are less costly but require power from either the receiver or a separate external amplifier.

Super-Audio CD (SACD): Sony introduced Super-Audio (SACD) in the fall of 1999. Warner Music launched DVD-Audio in early 2000 with a coalition of hardware manufacturers such as Toshiba, Panasonic, Pioneer, and Meridian. Record labels wanted to prevent digital copying so the players would have only analog outputs; this means six cables for multi-channel playback, which also requires a receiver/pre-pro with six pass-through inputs.

When Sony acquired Columbia records it decided that CD quality was not enough for archiving the musical heritage, and invented a digital storage medium of high density (1 bit resolution sampled at 2.83MHz) called Direct Stream Digital (DSD), later used as an archival format and recording medium for the next generation of SACDs. The format was made able to record frequencies above 20KHz (the CD limit), which are inaudible but affect the audible range since they still modulate lower frequencies.

Dual-layer "hybrid" SACDs would contain the new format as well as the CD standard 16-bit/44.1 KHz "Red Book" (as published by Sony/Phillips) layer, which makes them backward compatible with CD & DVD players as well as on SACD players. The stereo tracks are a separate mix, not fold down from SACD multi-channels.

Surround: See specific details in Dolby Digital, Pro Logic, DTS, Circle Surround, etc.

Surround Speakers: Surround speakers are normally placed to the sides/corners above the listening area. Additionally another speaker may be positioned behind the listener as 'center back' for some formats, and even one on the ceiling. They carry directional effects (Dolby Digital/DTS) and/or just sound field enhancements (DD, DTS, Pro Logic, Circle Surround).

Speakers for discrete full-bandwidth surround formats such as DD/DTS should be able to handle full frequency response of 20Hz-20KHz and be sufficiently larger to handle loud passages (compared to the ambience purpose of Pro Logic for example). Rear speakers are either bipole or dipole design; dipoles produce sound from the rear and front, out-of-phase from each other (for which some people recommend for surround); in the bipolar design the front and rear are in phase and sound equally.

There are different views regarding which type to use for music or movies, or for discrete and non-discrete surround formats, for directivity or dispersion, and for the

type of room in which they are installed. Consult your specialty audio store for your particular application.

S-Video (Inputs/Outputs): S-Video separates the luminance (Y) and chrominance (C) signals offering better picture quality and resolution than using standard composite/RF video connections. Use with S-VHS VCRs, and with other equipment as a second alternative to component video, if not present.

THX: License that identifies and certifies compliance with color and sound high performance parameters for home theater systems.

Timbre: Tonal characteristic of a sound determined by its harmonic structure.

Toslink: Fiber optic connection for digital audio developed by Toshiba.

Twitter: Type of flicker effect that occurs when white lines alternate within refreshing fields.

UHF (Ultra High Frequency): Subset of the television broadcast frequency that ranges between 470 MHz and 890 MHz. Most of the DTV broadcasting stations are currently using this band.

Underscanning: Effect caused by decreasing the horizontal and vertical raster size, allowing the four edges of an image to be seen into the screen, including skew and tracking (which should not be seen). See overscanning for a description of the opposite effect.

VC-1: In April 2006, the SMPTE (Society of Motion Picture and Television Engineers) released the VC1 standard for compressed video bit-streams, together with a Recommended Practices document to provide guidelines for interoperable solutions.

The SMPTE's Compression Technology Committee put together a working group to maintain the test materials and documents, and to administer the bit-stream exchange program. Reportedly, Microsoft, who contributed the decoder source code, a prototype encoder, and other resources towards development of the process, proposed the formal standardization.

The VC-1 documents are available at <http://www.smpte.org/>:

SMPTE 421M-2006, VC-1 Compressed Video Bitstream Format and Decoding Process

Recommended Practices:

SMPTE RP227-2006 VC-1 Bitstream Transport Encodings

SMPTE RP228-2006 VC-1 Decoder and Bitstream Conformance

Vertical Blanking: Automatic action of turning off the scanning electron beam in a CRT while returning from the bottom to the top of the image to draw the next set of lines.

Vertical Resolution: Measurement in the vertical direction of the number of horizontal lines scanned from top to bottom to complete a picture frame. The NTSC system has 525i lines (with 480i visible), which includes TV broadcast/satellite/cable,

laserdisc, VHS, and DVD. The ATSC DTV system includes three levels: 480i digital for SDTV, 480p digital EDTV, and 720p/1080i digital for HDTV, all visible lines.

Although not a broadcast format, HD also includes the 810i format of visible lines displayed within a 16:9 image when shown in some 4:3 TVs, as per CEA definition for HD updated in 2000. Vertical resolution should not be confused with horizontal resolution, which is the number of lines/pixels measured left to right in the horizontal direction.

VHF (Very High Frequency): Subset of the television broadcast frequency that ranges between 30 MHz and 300 MHz. Some of the DTV broadcasting stations are currently using this band.

Video Compression: General name given to the methods used to reduce the digital data in a DTV signal (and DVD), such as MPEG-2, so the signal can be transmitted/stored within the allotted limited bandwidth/space. See MPEG-2.

White Level: Level of the maximum picture brightness in TV, defining the range between the darkest and the lightest areas of the picture.

x.v.YCC: x.v.YCC is a technology established as an industry standard by the International Electronics Commission in January of 2006 that expands the current color data range of video by approximately 1.8 times. It is based on the "Munsell Color Cascade" a universal color chart defining the colors of natural objects and is used to evaluate color expression capability of displays, which provides the ability to display more natural and vivid colors similar to what the human eye can actually see.

Sony, Mitsubishi, Silicon Image, HDMI Licensing, LLC., and others are implementing and facilitating x.v.YCC, a technical standard that expands the range of colors of the current standard, BT.709-5, used for HDTV; it adds shades of cyan, bright green, etc. making the colors more natural and richer. Sony is implementing the technology under the name x.v.Color.

Y: Abbreviation for luminance.

Y/C: Y=Luminance, C=Chrominance (color). Nomenclature used for S-Video connections that separate both signals using 4-pin DIN connectors.

YPbPr: Analog component video connection with 3 cables. Also mentioned simply as "component" on the report. Some component connections are only for 480p (DVD or EDTV). HD enabled component connections should be specified as 720p/1080i or HDTV, otherwise, there might be a bandwidth limitation for HD signals, even when the connectors fit well.