State of H/DTV Technology

Impressive Growth and Inspiring Future

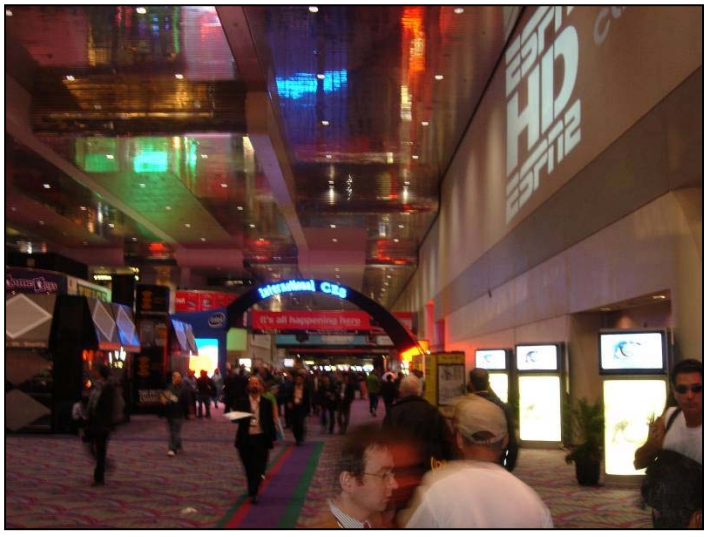
2006

By Rodolfo La Maestra March 2006

As with every year, this report reviews the state of H/DTV technology and the industry behind it. The information is up-to-date as of March 2006 and includes future products announced at January's International CES (Consumer Electronics Show).

If you are looking for a particular piece of equipment or technology that is not mentioned in this report, please consult earlier CES reports. These reports include previously released equipment that may still be available to consumers. Previous CES reports are available on the HDTV Magazine website at the following address: www.hdtvmagazine.com/reports/hdtv-technology-review.php.

These reports also provide the historical background of government mandates, industry agreements, satellite/cable plans, definitions, and descriptions of some technologies introduced at that opportunity. Together with this 2006 report, readers are able to use this series of CES reports to better understand the past, present and future of recently released products and technologies.



When applicable, I will provide a brief summary to give an historical perspective of a given subject so that the reader can be familiar with the background before getting into the detail of this year.

During the year, prior to CES, many announcements are made and industry events occur (such as dealer meetings, or conferences like CEDIA every September) which manufacturers leverage to introduce new products.

For these cases, I will mention the month of product introduction to provide a perspective of its maturity in the market. In addition, products announced at CES 2006 that are planned for release throughout 2006/7 are highlighted within each manufacturer grouping so the reader can have a view of the future.

Most publications only show current DTV products with few specifications. They exclude equipment expected in the medium-term future, and they do not analyze the

market to guide the reader in making the right choice. Hundreds of products are included in this report, with specifications and features intended to facilitate comparisons with other models, brands, and technologies.

Many people attend CES to plan future purchases and start saving for products that could be released months or years later; or rather decide to buy now a current product because CES helped confirm that it might not be worth the wait.

In this report, I highlight industry trends, the adoption/abandoning of H/DTV technologies, the remarkable increase in number and variety of flat panel displays, the growth of LCoS, the 1080p Holy Grail, the Hi-def DVD format war, ED in all its variances (SED, NED, OLED, FED), etc.

This report assumes that the reader has a basic understanding of H/DTV. The technical information provided might seem overwhelming to readers that feel the need to understand the basics first. If you would like to understand the basics of H/DTV, you may want to consult the Glossary and some of my tutorial articles at the HDTV Magazine website: www.hdtvmagazine.com.

All types of H/DTVs and technologies are covered in this report: RPTV (rear projection TV), FP (front projectors), Direct-view (CRTs, CRPs, etc), Plasmas (PDP), DLP (Digital Light Processing), LCD (Liquid Crystal Display), LCoS (Liquid Crystal on Silicon, including JVC's D-ILA and Sony's SXRD), and SED, OLED, FED, NED, etc.

This report also reviews DTV related equipment such as Hi-def DVD for playback and recording, HD tuning set-top-boxes (STB) for small-dish satellite, digital cable, and over-the-air (OTA) w/antenna reception, HD DVRs (Digital Video Recorders), and the implementation of digital video connectivity (DVI, HDMI and IEEE-1394 Firewire).

As always, this report makes more emphasis on H/DTV displays over 40" diagonal (except for a smaller few mentioned in the CRT and LCD-TV groups to round up the introduction of a new line). It excludes computer related HD-tuner cards, computer Hard Disk Drives (HDD) for HD video storage (a computer DVR), C-Band (big dish) satellite equipment, and some after-market modifications to HD-Set Top Boxes (HD-STBs) for DBS small-dish satellite HD recording (www.169time.com).

All the information about models, prices, and specifications has been researched and confirmed with product demonstrations, lab tests, industry press releases, technical material, and my manufacturer interviews at CES. Prices are consistently shown as

MSRP (rounding the 999s to the next dollar to make for easier reading). Product availability is stated as TTM (Time to Market) or TBA (when unknown).

As the industry grows in complexity, variety, and number of products, the effort to research, analyze, review products, and wrap with a full H/DTV coverage at CES with my projections is becoming an overwhelming task year after year.

Most people refer to this effort as a "CES report". The truth is: CES is just one piece of the industry perspective offered in this document. In most cases, I already know what will be appearing at CES beforehand because I follow the industry on a daily basis. CES permits me to see (and in some cases test) those ground breaking H/DTV products and talk to the engineers that participated in their creation. No press release can provide that, and you have it here.

Nevertheless, I still make the effort because maintaining the broad scope allows me to link all the pieces together, which facilitates a deeper analysis from a wider perspective across manufacturers, technologies, and the industry in general. The readership benefits from a unique report, a historic and summarized statement of a year of the H/DTV industry, which also becomes a research tool, rather than just showing the photographs of selected new products with modest background information, as most publications do, when they do.

Although considerable effort was made to consolidate and verify the correctness of all the complex data included in the report, I cannot assume responsibility for omissions or errors.

Any information you might want to contribute to correct or enhance the usefulness of this report would be certainly welcomed. Should you have any comments or questions, please feel free to contact me at rodolfo@hdtvmagazine.com.

Thank you for your continued support and interest in my work.

Your HDTV Magazine at CES 2006
Shane, Dale, and Rodolfo

Rodolfo La Maestra

We have a lot to cover this year, now reaching 207 pages, so let us time travel to the future of H/DTV.

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H/DTV Highlights

CES attendance has increased year after year. CES 2006 received 150,000 attendees (142,000 last year), and more than 2,500 exhibitors. Comparatively, CEDIA had 26,000 attendees,

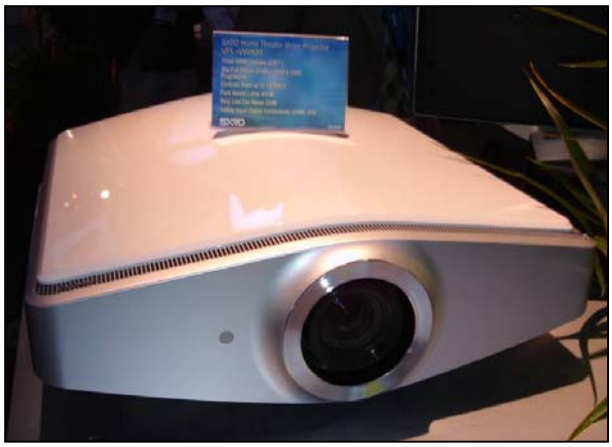
and about 500 exhibitors. CES is consistently increasing the attendance by about 8-10 thousand attendees per year over the past few years.

3-D HDTV - Philips announced that the company plans to introduce in two years an HDTV that can play 3-D content. The technology is in the lab at this time and has not been shown to the public yet. 2-D content will be able to be viewed as 3-D; the movie studios are hoped to be more supporting of 3-D movies. LG made a demonstration of a pair of **3-D LG LCD** 42" panels (left).

In-Stat expects over 54 million TV households will have at least one HDTV display by year-end 2009, I expected the double by the end of 2008, check my analysis and projections. The 2007 deadline for **DTV transition** has been extended for another 2 years and is now set for February 17, 2009; although it was already signed by the President in early February 2006, a clerical typo challenges its validity. The bill also budgeted for a subsidy to supply up to two $40 vouchers per consumer to defray most of the cost of two digital-to-analog converter boxes per household that would allow the viewing of digital broadcast content using legacy analog TVs. The bill also budgeted for a "much needed" program to educate the public about DTV and the transition from analog.

Additionally, related to the DTV transition, the FCC approved a shorter **integrated-tuner** implementation schedule; it now extends its mandate to sets below the original 13" threshold. Read all the details at the DTV Transition section.

LCoS has increased it presence during 2005 with newer and better looking RPTV and FP sets from Sony (SXRD VPL-VW100, $10,000, on the right), JVC (D-ILA), in addition to the RPTVs of Brillian and several others.



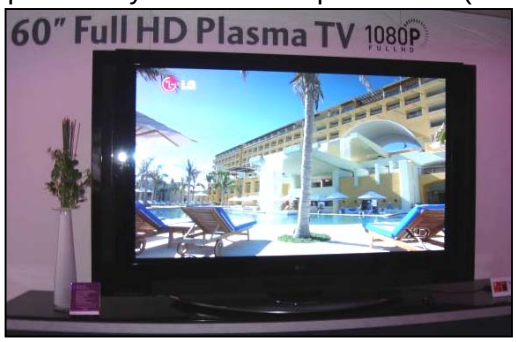
Check the LCoS section, and the section dedicated to how Brillian implemented their video processing on their new LCoS RPTV (left). LCoS is becoming stronger every day, however, in March 2006 LG announced the withdrawal of their LCoS 1080p RPTVs due to "certain part procurement issues", VP Bob Perry said.

Pacific Media Associates reported that the **1080p market** sales grew from 13% in August 2005 to 24% in September, and 32% in October. Many manufacturers introduced newer 2006/7 RPTVs lines but only a few announced 1080p digital inputs for 2006. One company that announced **1080p inputs** on their next 2006/7 DLP RPTVs is Samsung, now joining the group of Brillian, HP, and many front projectors with such feature. I hoped that Sony would officially announce that feature on the 2006/7 line of second generation SXRD RPTVs, but Sony only made informal comments that their new RPTV line would have 1080p inputs to complete the loop with 1080p Blu-ray. Many manufacturers still blame their lack of 1080p inputs on the uncompleted HDMI 1.3 specs, which they say would eventually bring 1080p on the HDMI chips they use. Silicon Image (HDMI) declared that the specs were 1080p compliant since day one, however, some equipment manufacturers might have chosen to use lower cost HDMI chips designed for non-1080p purposes (a 1080i TV for example), or to save on a non-1080p circuitry before the TV display stage that can show 1080p. The most common excuse heard: "there is no 1080p content out there". You can read more about the issues surrounding 1080p sets in the series of 1080p articles on the HDTV Magazine website, and in the Digital Connectivity and Video Processing sections of this report.

CRT is still alive! CRT is still the best bang for the buck. Toshiba stated that this year the industry expects to reach 17 million CRT units, 7 million of those integrated (with ATSC tuners). Although Toshiba is exiting the CRT RPTV market this year, the company announced some new CRT direct-view tube sets for 2006; the current Custom Series RPTV line is priced for mass sales and in order to get around the FCC's DTV tuner mandate, Toshiba is **omitting NTSC analog tuners** from two models: 51" $1,300, 57" $1,500. **Samsung CRP (CR panel)** on the right, LG, Thomson, and many other manufacturers introduced new 2006 lines as well. **Hitachi** announced their new CRT RPTVs: 51" $1300, 57" $1500,

and 65" $1800, TTM Apr/May 06. **Thomson** continued with their integrated CRT 480i SD on 27" and 32" (8 models) at a $400-$600 range (TTM Mar 06), as well as a line of 16:9 CRT 1080i on the 26/27 inches for $550+ with ATSC tuner. Thomson announced **CRT RPTV monitors from 52-61" on the $1,150-$1,500** range without CableCARD/ATSC tuners and without IEEE1394, TTM Jun 06. However, **LG abandoned CRT tube TV in Europe** (Oct 05), to concentrate in thin TVs. The CRT market in Europe was expected to drop 20%, double LG expectations beginning 2005. Check the CRT section to review the manufacturers that still support CRT as direct-view, RPTV, slim-line, etc.

1080p plasmas were shown at various sizes (Panasonic line or LG's 60" below left for example). Oversized **100"+ plasmas** were also shown as technology statements from several companies (Panasonic 103" included further at the end, and LG's 102" on right), some manufacturers even stated their intention to actually produce the units. A couple of previously shown 1080p Plasmas (such as the



71" LG, and the 80" Samsung) were shown again this year, their availability was delayed for almost a year. The **Samsung's 80" plasma panel** (below) is now in production. Samsung reported that four units were already delivered, at $150,000 !! ("each"). The panel can only be special ordered from Samsung, and the price includes installation and a multi-channel audio system. Check the section on plasmas to read Samsung's official statement regarding why this plasma was unable to be released earlier at the original price of $39,000 (2005 CES).

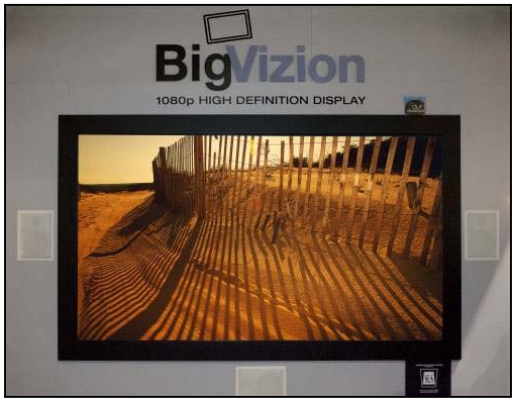
Large LCD panels are still fighting for the upper 40/65" plasma market; they do with 1080p resolution (Sharp's LC65D90U on left) and with prices that are dropping quite rapidly, as well as plasmas. Most LCD panels do not yet operate in the 4ms response-time range but

they claimed to have improved their speed enough to reduce the effect of lag on fast moving images, you be the judge.

Oversized LCD panels were also demo again at CES, although no price tag or time of availability was disclosed on some units. Some companies indicated that their sets were just technology statements, while others said they were serious into producing what they are prototyping. Samsung's 82" LCD is above on the right.

A **Two-way viewing angle LCD** panel was demonstrated by Sharp, suitable to auto 7" (in production), and commercial applications 45", the latter as a technology statement (left).

Oversized RPTV DLPs (below) from Optoma were also on display at the



show in 80, 90, and 100 inches, targeted for in-wall installations. BigVizion displays are priced $15,000 to $20,000, TTM early 2006; check the DLP section.

Hitachi announced their unique **HDD and Blu-ray combo recorder** (below) as the

world's first 1-Terabit HDD and dual digital recorder capable of recording two simultaneous HD broadcasts, for 128hrs of digital recording or 1700 hrs in extended play mode. It also supports the Blu-ray/DVD/CD formats and stores up to 2 hours of HD in a Blu-ray disc. Hitachi showed a Blu-ray player at CES.

On the **Hi-def DVD formats war,** both blue-laser formats made their demos and announced their studio support and launching plans, March 2006 for HD DVD (Toshiba HD-A1, below, $500), April/May for Blu-ray (Pioneer, left, $1800). One important

distinction that might attract videophiles with HDTVs with 1080p inputs is that most Blu-ray player manufacturers confirmed 1080p output capabilities (Sony BDP-S1 player is capable to upconvert all media to 1080p/60fps, Pioneer outputs the Hi-def DVD content as 1080p/24fps). 1080p outputs were not offered in the Toshiba HD DVD players expected by March (only 1080i/720p), although the RCA HD DVD seemed to have that feature (confirmation is needed). More details included at the end.

AACS decided to **down-res** 1080i over component analog for all Hi-def DVD formats if the content in the disc instructs the player to activate the restriction. About 10 million HDTVs sold with only component analog inputs between 1998 and 2004 (and non-HDCP compliant HTPC viewers) would still be able to display the HD disc but at a lower resolution down to 25% (960x540). Check the Content Protection and Hi-def DVD sections for more detail.

OCAP middleware is being aligned as the solution for bidirectional cable services, to take the place of the recently implemented unidirectional CableCARD system. Another example of how calculated obsolescence of technology puts consumers once again to foot the bill with the millions of CableCARD integrated HDTVs they purchased over the last couple of years, and over the next two until the OCAP replacement is up and running, all with the visionary FCC approval. Check all the details of the other components of OCAP in the Cable section.

Some TV manufacturers are now **removing the cable tuners on the newer lines**, or suiting the newer sets with only in-the-clear cable tuners (no CableCARD), i.e. Thomson is eliminating CableCARD from RPTVs on 2006 to cut costs (as well as eliminating IEEE1394), other manufacturers are even removing the traditional NTSC tuner to avoid installing the ATSC tuner mandated by the FCC (when the NTSC tuner is present), declaring their sets as tuner-less monitors, like Westinghouse further below. I predicted the effects of extra cost of not-needed tuners to consumers in my earlier reports over the past 3 years, when the FCC tuner mandate was issued. I still hear the echo of industry leaders saying that tuners were cheap and unidirectional CableCARD was the way to go. Some other companies like Brillian were smart enough to anticipate the short life of the unidirectional CableCARD approach and decided not to install any cable tuner on their new LCoS set until a bidirectional solution is available. Consumers wanting to view TV on these tuner-less monitors would require an external tuner (OTA, cable, satellite STB). However, as you will see on the TV viewing statistics section, over 85% already have some kind of STB because they subscribe to cable or satellite.

King of the Show: Sony 4K **Digital Cinema** SXRD projector (on left), specs included on the 2005 report. Dual projectors were used for a spectacular image on a huge screen (it seemed to me to be about 30 feet wide). The clarity and

detail of such large image was the best I have seen on that size, even on commercial theaters. Check the LCoS section for details.

Westinghouse has a new line of LCD monitors in the 37" and 42" range that are tuner-less monitors and comply with the FCC ATSC tuner mandate because they omit NTSC tuning. They are true monitor products, and include DVI, and component video.
37" LVM-37w1 $2,300, 1080p panel, accepts 1080p on DVI and VGA, no tuners
42" LVM-42w2 $2,800, TTM Jan 06, 1080p, DVI, component, no tuners.

Although I did not have the chance to see it personally, Westinghouse informed me that they demonstrated the **world's largest ultra high resolution LCD** with 8 million pixels, a **56" 3840x2160**, 8 ms response time, 600-nit, 1000:1 CR, how I could have missed that is beyond me.

Matrix Stream IPTV Technologies claimed to have the **world's first HD VOD / IPTV STB.** The unit uses H.264 AVC (advance video codec) video compression, and has 1080p outputs over HDMI. The IMX 1020 HD STB on the right is available for trials Jan 06, $ TBD, TTM 1Q06. The IMX 1100 PC Player would be available late Jan 06 from http://www.movie99.tv/. Over 300 free channels from around the world and 150 free DVD and HD quality movie clips would be offered. Check all the specs in the HD-STB section of this report.

DIRECTV and Dish Network demo their new multiple-tuner HD-STB DVRs with MPEG-4 satellite compression of HDTV, and disclosed upgrade programs for existing customers. Check the details in the Satellite section (DIRECTV H20-250 HD DVR model, TTM 2Q06, on the right) and check all the specs and details of these and many more units in the HD-STB section.

Runco demonstrated their clever motorized anamorphic lenses on their projectors, electronically in sync with the new 2:35.1 Stewart screen (Cine Curve Constant Vertical Height for perfect Cinemascope, mentioned further to the end of the highlights), which motorizes the opening and closing of the screen sides to adapt to 2.35:1 and 1.78:1 (16x9) and use the full vertical height of the screen. Runco's *CineWide™ and CineWide™ with AutoScope™* technology is optional on all models to obtain full vertical resolution capability of their DMD chips, displaying movies

formatted in the 2.35:1 aspect ratio with increased resolution and brightness, and motorized anamorphic lens assembly via RS-232 commands.

SED Cannon demonstrated their SED technology (in partnership with Toshiba) with the panel on the right. No TTM, no MSRP. Check the details in the section covering SED and similar technologies.

Toshiba demonstrated the SED technology as well. The company forecasts that by 2008, SED will account for 20 to 30 percent of the 40W-inch and larger flat-panel TV market.

Gateway announced in July 05 its withdrawal from the plasma and LCD business.

Toshiba declared that their **1080p** sets would cost only $500 more than their 720p sets, while Samsung was charging $1000 more, but announced a price reduction for 2006 (see Toshiba and Samsung details at the DLP section). By the fourth quarter of 2006, Toshiba forecasts large-screen flat-panel street pricing to begin to level off between plasma and LCD. A 42W-inch high-definition plasma set will sell for about $2,411 compared to about $2,740 for a 42W-inch 1080p LCD TV, Toshiba's Ramirez predicted. Toshiba did not announce any 1080p RPTV with 1080p inputs at CES 2006. Furthermore, in my meetings, Toshiba commented that they did not consider 1080p inputs a necessary feature, proof of that is the lack of 1080p outputs on their new HD DVD players expected for March 2006.

Philips introduced LCD panel elegance on the MiraVision line, a pair of 32" and 42" LCD panels that feature a **reflective mirror** when not in use (and hides the wiring). Check the LCD section for details.

At CES 2006 and during 2005, **HDMI** digital connectivity was seen implemented on a larger volume of pre/pro and audio/video receivers of various price ranges, not just on expensive top-of-the line units as it used to be.

Consumers that read this report for that information might no longer need the section with a short list of units suited with HDMI/DVI. For that reason, the list was not prepared this year. However, there are still a number of connectivity issues when a consumer expects a particular **multi-channel audio capability** from the audio system (such as DTS-HD or Dolby TrueHD) and the HDMI chip/spec implemented in the equipment is not capable. Check the Multi-channel Audio for HD section for a comprehensive coverage of codecs and connectivity. Regarding HD video, some 1080p TV manufacturers are reducing costs by implementing HDMI chips not capable of 1080p, and/or by designing the TV incapable of internally handling the full bandwidth of 1080p, even when is sold as a 1080p TV. At CES, a large number of manufacturers blamed the lack of **1080p-input acceptance** on their new line sets to the HDMI spec itself. Many said they were waiting for the HDMI version 1.3 to be released (1H06). According to Silicon Image, HDMI has been 1080p compliant since the first version was released, however, some HDMI chip manufacturers produce them without 1080p capability because some chips are targeted to non-1080p applications, like a 1080i TV input or a DVD player. If TV manufacturers install those on a 1080p set to cut costs, it is a decision of the manufacturer, not the HDMI specification.

Please look into the subject of HDMI in 1080p Equipment within the Digital Connectivity Implementation section for the coverage of **1080p HDMI transport** and **1080p pass-thru** features on related HDTV equipment.

If you need a **DVD player with 1080p upconversion,** there is a hi-end player already available (and probably the only one): Classe Delta CDP-300 DVD player w/1080p outputs. That is, if you do not mind paying more for the DVD player than most people pay for an HDTV.

Texas Instruments has recently released a consumer DMD DLP chip with 2+ million mirrors, one per pixel for the full 1920x1080p HDTV resolution. The chip is targeted initially to the front projector market. Check all the new products in the DLP section. Most 1080p DLP implementations use a 960x1080 chip to produce a 1920x1080 image, the chip that has half the mirrors of the image pixel count. The DLP engine uses a mirror tilting technique at double the speed to complete the full 2 million-image pixels in two horizontal image shifts of 1 million mirror reflections each ("wobulation"). According to TI, the human eye would see the two images as one at that speed. The technique was criticized by the competition because it did not use a chip with the two million-pixel mirrors, as the other technologies do, such as LCoS (Sony's SXRD, JVC's D-ILA, eLCOS, etc). TI did not disclose any plans to supply a similar chip for RPTVs, and commented that it was a market/manufacturer decision to request to TI 1080p chips if they are demanded for RPTVs, likewise, no

announcements were made by any DLP set manufacturer of RPTVs regarding new lines using this new chip.

Some CES demos of front projectors using the new two million-mirrors-1080p-chip were stunningly good, like the **Optoma 81 1080p** ($10,000, TTM 3Q06, below) on a 135" screen, probably the best 1080p FP in the price range.

Sharp's XV-Z20000 DLP 1080p, $TBA, TTM 3Q06, 1920x1080p resolution, Sharp's CV-IC III Video Scaling Circuitry, DVI/HDCP and HDMI inputs. The demo of this projector at CES was excellent (below, left).

Marantz DLP 1080p new projector VP-11S1, TTM TBA, $ TBA, shown as prototype, 700 ANSI, 5000:1 CR, 2 HDMI, 2 component, Gennum video processing (right).

LG introduced the **first wall mount projector** (below). The AN110 WXGA DLP, 768x1280, 1000 ANSI, 2500:1 CR, 24dB noise, HDMI.

Many manufacturers demo their use of **LED backlight** for their TV sets, and many also showed **slim LCoS RPTVs** at CES, such as Sony and JVC (56" RPTV 10" deep D-ILA at left) hanging from the wall (JVC showing the set's depth at right).

JVC showed their current **D-VHS** model and indicated that although there will be no more new D-Theater pre-recorded movies released in the format, JVC considers D-VHS as the only viable recording format today, other than time-shifting on DVRs, which is not recording for archiving purposes.

In other words, JVC did not discontinue the D-VHS format, but since there are no new products on the D-VHS format, there will not be a section with D-VHS equipment this year in this report. All the available models can be reviewed in earlier reports.

JVC does not have any plans to release newer 1080p sets that will accept 1080p; they claim that the reason for which their sets do not accept 1080p is because the HDMI 1.3 spec is not yet out …. Similar statements are being issued by almost all 1080p HDTV manufacturers to justify their design decisions. Check in the LCoS section of this report for my review of **JVC's 70" 1080p D-ILA**, which I praised last year. I will let you do the reading to find out what I noticed when viewing it this year.

Pocket Projector

Epson super small projector, 800x600, 3 LCD, LED source, 1.1 lbs, technology exhibition (left; specs on right). Details in the LCD Projection section.

Viságe™
Taking Projectors Out of the Dark

Screen Innovations
The company introduced a material that absorbs extraneous light and allows images to be seen even in lighted rooms, 60-120 inches for 16:9 screens in 1-inch increments (on the left).
www.screeninnovations.com

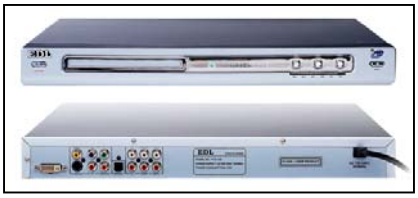
Stewart
Cine Curve Constant Vertical Height for perfect Cinema Scope screen, 2.35:1 aspect ratio, TTM January 06, picture on left.

Electronically masks the sides for 16:9, and 4:3 viewing, the screen complements projectors with anamorphic lenses, Micro perforation available for transparent audio, BRIC control system.
www.stewartfilmscreen.com

Samsung showed their demonstration of a High-Definition Audio Video Network (as part of the **HANA** Alliance development effort), on the right, check the DTV Standards - Update section.

JVC showed their **multi-screen** system (below)

Taiwan's **FVD high definition DVD** was introduced on March 28, 2005 and players introduced in May for $175 with 10 free movies in Taiwan. With a sales promotion in Europe and the US, the global volume was estimated to reach 100,000 players in 2005, 3 million in 2006, and 5 million in 2007. Later, Taiwan's Kolin offered in November 2005 an initial sales promotion period for their first KVD-1080 player with HDMI cable and three 1080i FVD movie discs, all for $240. Content is available mainly from independent studios but the alliance is making efforts to expand the offering of titles from other major studios, to reach an initial goal of 100 titles. Check the full coverage in the Hi-def DVD section.



Panasonic 65" TH-65PX600U, $TBD, 1920x1080p, TTM Aug/Sep 06, expected MSRP $8000 when released in the US, <u>1080p acceptance expected for later in the year</u> (upon HDMI vs. 1.3 release, although 1080p is actually not exclusive on the 1.3 version), PC input, NTSC/ATSC/QAM CableCARD tuners, HDMI version 1.2 inputs with HDAVI control, TV-Guide EPG, left, good blacks, skin color very nice, all natural colors, pixel structure viewable from 3 feet away, **<u>best plasma on the 60+ range,</u>** (plasma section).

Scientific Atlanta MCP-100 HD-STB/cable DVR/Hi-def DVD recorder
This STB was introduced a year ago at CES 2005 having HD recording ability on the HDD DVR and on its internal DVD format (check page 93 of the CES 2005 report for the original review). The unit was introduced again at CES 2006 and now has a model number: MCP-100 DVR. Includes a DVD Recorder/Player and is being tested in MSO labs, expected to enter beta testing soon. The recording abilities are designed to respect key content protection flags including 'copy freely', 'copy once', and 'copy never' tags. Features Dual DVR recording, Multi-Room™ DVR, High-Definition, DOCSIS and OCAP capabilities, External SATA for storage expansion, Multi-Room DVR feature enables viewers in three other rooms in the home to access content stored on the DVR hard drive. Check the HD-STB section.

HD Tivo Series 3 HD 250GB DVR, dual HD recording (300 hrs SD, 30 hrs HD), dual CableCARD slots on back (Multi-stream 2.0 or Single-stream 1.0 variety) to support two signals, six tuners (dual cable tuners, dual NTSC tuners, dual ATSC tuners), can use any tuner pair, supports digital and analog cable, external SATA drive, backlit remote, TTM 06, supports MRV and TTG, coax cable in, coax antenna in, no RCA or S-video inputs, it has the following outputs: HDMI, component, composite, optical audio, RCA stereo out, 2 USB ports, 10/100 base T Ethernet jack connections, outputs 480i/p/720p/1080i and pass-thru, encodes analog content with MPEG-2, supports playback w/MPEG-4 AVC/H.264 and WM9.

MovieBeam announced a Video-on-demand service for standard- and high-definition catalog and new movie releases for playback at any time from a 160GB hard drive. The service includes DVD releases and subscription-free model for movie rental for 24-hour viewing periods for $1.99 for catalog titles and $3.99 for new releases, an extra $1 fee is charged for HDTV titles. The HDD STB caches 100 movies and sells for $199 after a $50 rebate; $29.99 activation fee, needs periodic connection to a telephone jack, no need for a broadband connection, uses part of the PBS bandwidth and tunes with an OTA antenna.

Samsung LED based DLP RPTV, 56" HL-S5679W $4,200, TTM Apr 06, 1920x1080p, LED light replaces current UHP bulb, 20,000 hrs life, 7 seconds turn-on time, ATSC/NTSC/CableCARD tuners, 10000:1 CR, IEEE1394, 2 HDMI 1080p inputs, quieter, black glossy finish (left).

Oleiva Signature 1080p LT-HVi Ultra premium line with 37, 40, 42, and 47 inches, using HQV Silicon Optix Realta chip, ATSC/NTSC tuners, 2xHDMI, 3xcomponent, VGA, all glass front with antireflective coatings, 1600:1 CR, 800cd/m2. The 42" (LT42Hvi $3,500) and 47" (LT47Hvi $4,000) are expected by 2Q06, and are said to support 1080p inputs, (left).

HD Gaming/Hi-def DVD, Microsoft announced at CES 2006 that they would release an external drive to allow the Xbox 360 game console to be able to play HD DVD discs, and shortly afterwards Microsoft commented that, eventually, they could even do the same for a Blu-ray external drive. However, it was graciously corrected a few days later as "we have no plans for Blu-ray"….

Sony showed the PlayStation 3 console (right) at CES, planned for release later this year (May in US, Spring in Japan). It would play Blu-ray discs at 1080/60p and 1080i over HDMI. With High Quality Image Processing driven by RSX Graphic Processor, 32bit floating point processing for color video and audio. Blu-ray playing performance was claimed to be equal to the near future Sony's Blu-ray standalone player. The unit on the floor showed to have 2 HDMI, 4 USBs, audio digital out, 3 RJ-45, A/V multi out. The console was claimed to also play live television when connected to a TV using Wi-Fi Internet streaming. Check the Hi-def DVD Section.

HD DVD March launch would be accompanied by gradual release of titles from

Warner Home Video, Paramount Pictures, Universal Studios, HBO Video, New Line Entertainment, and recently the following two: Europe's Studio Canal and the Weinstein Company (Miramax previous owners), and Customflix.com (Amazon owned) for independent and small filmmakers. These movie studios represent more than half of produced movies, according to Access Hollywood. Upon launch there will be only a few titles released such as Twister, Lethal Weapon, U-571, and Apollo13, but by June 50 titles would be available, to total 200 titles by December's Holidays. The titles will become available in a mixture of HD DVD discs and hybrid discs that contain also the DVD version of the content, which were said to cost a few dollars more. **Blu-ray April launch** will be accompanied by the gradual release of about 100 titles during 2006 from six studios as follows: Paramount Pictures, Warner Home Video, Twentieth Century Fox Home Entertainment, Sony Pictures Home Entertainment/MGM/Columbia Pictures (Sony will release 4 movies per month, increasing to 10 per month by the end of 2006), Lion's Gate Home Entertainment,

Buena Vista Home Entertainment/Disney. Eagle Rock Entertainment will provide 20 music artists such as Miles Davies and George Benson.

As mentioned before, Panasonic showed a **103" 1080p plasma** panel prototype as a technology statement (right). Check details in the Plasma section.

Regarding video processing, **Silicon Optix's Realta HQV and Gennum's VXP** high quality chips are being increasingly implemented into a good number of scalers and display devices from RPTVs to front projectors. According to Silicon Optix, **HQV** will be implemented in the following products during 2006:

Digital Projection VIP1000 video processor Q1/06
Lumagen RadianceXD video processor Q3/06
Calibre Vantage HD video processor Q1/06 (right)
Algolith DragonFly video processor Q1/06
Syntax/Oleiva Signature Series LCD Q2/06
BenQ projectors Q3/06

Gennum demo their **VXP** video processing technology which incorporates fourth generation broadcast quality image processing algorithms, which deliver superior SD and HD video image quality. The key features of VXP technology include:

- 1080p adaptive de-interlacing for optimal image sharpness TruMotionHD™ 1080i and resolution.
- FineEdge™ dynamic directional interpolation to eliminate jaggy artifacts found in traditional de-interlacing algorithms.
- FidelityEngine™ image enhancements for removal of unwanted noise and improved detail and uncompromised image quality.
- RealityExpansion™10-bit image processing for eye-catching natural imagery."

VXP supports picture-in-picture (PIP), picture-on-picture (POP) and picture-by-picture (PBP) applications, and supports all VESA and SMPTE formats up to 2048 lines by 2048 samples, universal frame rate conversion and full programmability for dynamic effects.

Fidelity Engine Processing

Check the HD Signal Processors section for specs of new video processing products.

Sony HDR-HC3 was quoted on Jan 26, 2006 as a new HD camcorder expected to be announced in the next few months. It is unknown if the HC3 would be a replacement of the HC1, or it is a lower level version of it (removed the mike jack and zoom ring). Records 1080i HD, 1/3" CMOS sensor, 2,103,000 gross pixel count. Gross pixel count of 2,103,000; a 1,076,000 effective pixel count in 4:3 mode; a 1,434,000 effective pixel count in 16:9 mode; a 1,991,000 effective pixel count in 4:3 still mode; and a 1,493,000 effective pixel count in 16:9 still mode. HDMI output.

Sanyo introduced their **Xacti HD1** video camera, $800, TTM Mar 06, with ultra-res an ultra-clear 2.2in OLED display with 210,000 total pixels display that flips out from the camera and rotates up to 285 degrees on axis for taking video or still images in otherwise difficult locations, pocket-sized, tape-less combo camera, weighs 8.3oz, can simultaneously record 720p HD video (MPEG-4 at 30fps) and 5.1 megapixel still images to SD flash memory card, 16:9 widescreen format (HD-SHQ / HD-HQ modes), (right).

Although Samsung has withdrawn their effort of making a universal **Hi-def DVD player**, LG announced in March 2006 that the players in both formats they planned later this year will not be released, and instead the company is planning to develop and release a dual-format player in late summer/early fall "in light of the uncertainty in this early stage of the market for pre-recorded high-definition optical discs", LG's VP Bob Perry said. Read the details about universal players at the Hi-def DVD section.

Thomson discontinued the **ultra-thin RPTV** DLP line (co-developed with Infocus).

In February 2006, **Toshiba announced in Japan "REGZA"** their new brand name to be used on all of Toshiba's flat-panel TVs that incorporate the company's proprietary "PixelPure" high-bit image processing technology. Initially the name would be applicable to LCD panels (which use PixelPure, plasmas do not). In the plan, 11 LCD panels will be introduced on March 1 in Japan between 26" and 47" using the REGZA name. The use of the "Cinema Series" naming for selected products does not interfere with using REGZA naming for PixelPure products. SED, using the PixelPure technology, would be expected to also use the REGZA naming when the first SED products are out later in 2006, but it was not confirmed by Toshiba.

Enjoy the rest of the report.

H/DTV Implementation

Background Summary (1998-2004)

As mentioned on previous reports the original date planned for the end of analog broadcasting and switch to DTV was 2007. The FCC provided each station with one additional six MHz channel slot so they can broadcast their current analog channel and the DTV version of it simultaneously during the transition period.

The plan established that by 2007, or when 85 percent of the nation receives DTV, whichever comes later, each broadcaster is expected to return to the FCC one of the two channels lent for the transition. That space on the spectrum would then be available for auction by the FCC.

In 2002, television manufacturers and retailers were asked to adhere to a phased-in schedule that would lead to terrestrial OTA DTV tuners in all television sets by Dec 31, 2006.

The FCC then mandated that all TV sets 13-inches and larger and other products that normally carry TV tuners –such as VCRs, personal video recorders, etc. were to include ATSC terrestrial DTV tuners by July 1, 2007.

Under the five-year phased-in guidelines DTV tuners were 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 were to add DTV tuners by July 1, 2005, and 100 percent by July 1, 2006. The rest were to conform by July 1, 2007.

A cable agreement plan was also approved for phased-in use of two digital interface connectors on new digital cable-ready TVs and/or cable set-top converter boxes, including a) Starting April 1st 2004, IEEE-1394 'FireWire/iLink' connections with Digital Transmission Content Protection (DTCP) for recordable and networkable compressed video streams, and b) By July 1, 2005, the non-recordable DVI/HDMI with High-bandwidth Digital Content Protection (HDCP) connections on digital televisions and cable set-top boxes.

The agreement was made for an integrated <u>one-way only</u> digital cable television tuner. Under this unidirectional agreement, bi-directional features that require a return-path of the cable system, such as video-on-demand (VOD), impulse-pay-per-view, and the use of cable-operator enhanced electronic program guide services, provided by the Cable Operator, would <u>not</u> be available, and a separate STB would be needed for those integrated TVs.

By implementing this interactive version of POD, digital televisions would eventually be able to directly receive interactive digital programs without the need for a digital set-top-box from their local cable provider.

In August 2003, the FCC announced the updated progress in the establishment of the two-way interactive plug-and-play cable interoperability agreement. Under this two-way interoperability agreement, sets with interactive functionality will be labeled "Interactive Digital Cable Ready."

Digital TV sets capable of displaying one-way programming services, including premium channels, would be labeled 'Digital Cable Ready', and they require smart POD cards that will be supplied by cable TV operators to unlock scrambled channels. The POD card is now called “CableCARD.”

CableCARD

According to the agreement, by July 2004, digital cable operators were to provide a CableCARD to subscribers that request one.

The Updated Plan (2005 and later)

New Deadline, STB Subsidy, Public Education Program

During the year 2005, lawmakers, government, and the HDTV industry in general, have been very active in preparing, participating, and reconciling proposals to reach agreement regarding the DTV implementation date, STB subsidies to consumers, etc.

Although I normally provide a detailed background to benefit the reader with a research tool that records important events of each year, it would not be productive for this section to be clogged describing the many intermediate efforts or unapproved proposals of 2005, when the final outcome has been reached already, details further below.

As part of a $40 billion budget-cutting package, it was reached a compromise DTV bill ending analog television services by the hard date of February 17, 2009. The compromise of date, budget, subsidy, etc. was achieved after doing an effort to reconcile the proposals of Senate Commerce Committee’s (April 7, 2009), with the House Commerce Committee’s (December 31st, 2008).

The bill finally passed as 216-214 on February 1, 2006, and the President signed it into law on February 8, 2006. The new hard date for the discontinuation of analog broadcasting is February 17, 2009. However, in late February 2006 it was discovered a clerical typo on the budget part of the bill that affected the DTV part of the bill, an issue that remained to be solved as of this writing.

According to some sources, the February 17, 2009 date was apparently selected considering that is two weeks after the Super Bowl and a month before the widely watched National Collegiate Athletic Association basketball tournament.

The auctioning of the analog spectrum has a new date as well: January 28, 2008. It is estimated that such auction could raise about 10 billion for the federal budget.

A five million dollar budget was also approved for a consumers awareness program. The legislation would also set up a $1 billion program for emergency workers to upgrade their communications systems.

A DTV tuner-box subsidy was also agreed (Senate proposed 3 billion, House $1 billion), and approved as 1.5 billion. The subsidy is to help consumers that rely on OTA TV broadcasting to obtain a Digital-to-Analog converter box that would allow the viewing of DTV content on their existing analog TVs. Consumers that need the economic support to acquire a converter could request up to two $40 coupons. It was estimated that converter boxes would cost about $60 each in the future; the two coupons cannot be applied to one box. This would not affect consumers who own digital televisions or subscribe to satellite services or digital cable services, which service provider already supplies the necessary decoder equipment.

Although the House proposal had it included, the agreed bill excluded language that would have allowed HDTV broadcast signals to be down-converted to analog by cable operators at the head-end, which would have permitted cable subscribers to view digital content using the existing analog TV's without any changes at their homes (for up to 5 years after the transition).

Such initiative would avoid requiring the acquisition of a cable digital-to-analog converter at the viewer's end, an investment estimated to be more expensive than the down-conversion at the head-end, which would have required also the continuation of the analog version of those digital channels within the cable service, and the cable spectrum required for that duplication. According to some industry estimates, about 40 million cable television households with analog TVs would be required to get a box upgrade (and pay) for digital cable service (to converted down to analog for viewing).

The bill also excluded language addressing a) a mandate to cable for the must-carry of DTV multi-channels broadcasters pushed for, and b) the Broadcast Flag. Both issues would affect directly a broadcaster's future.

TV Statistics

There are various estimates of how many televisions are depending upon receiving TV broadcasting. The broadcasters themselves estimate the number to be in the order of 70+ million television sets. CEA research shows (Sep 05) that "currently only 32.7 million (or 11.5 percent) of the 285 million television sets used in the U.S. are used to view over-the-air television programming; television today is largely a wired (i.e., cable or satellite) service."

Below are some statistics that the CEA prepared to highlight the distribution of US TV viewers by type of service, as follows:

CEA calculations are based in part from a Nielsen Media Research that shows 109.7 million U.S. television households, each owning an average of 2.6 TVs. Additionally, based on Opinion Research only 5.2 million (3 percent) of TVs in cable subscribing households are not connected to cable service, approximately 474,000 of those view non-TV content, therefore 4.7 million TVs (less than 3 percent) in these households tune to OTA television.

Regarding satellite services, 7 million (9.8 percent) of 71 million TVs in satellite households view OTA broadcasts, and only 200,000 of the 3.46 million TVs in households subscribing to both cable and satellite are used for OTA viewing, CEA said.

CEA's Shapiro continued: "Clearly, the vast majority of TVs in the United States are not used to view over-the-air television and we can presume that these numbers will diminish as more and more Americans subscribe to pay TV services, including coming technologies such as TV-over-IP, via telephony and even power line. More than 88 percent of today's TVs are connected to cable or satellite service or are used to play video games, watch pre-recorded content or some other non-broadcast television function."

"Of the total TV households, the survey found that 65.7 million (60 percent) subscribe to cable, 26 million (24 percent) subscribe to digital satellite and 2.7 million (2 percent) subscribe to both. Another 2.1 million households (2 percent) report that they do not subscribe to a pay TV service nor use an antenna to receive over-the-air television."

"The finding that approximately 86 percent of American homes receive cable, satellite or both mirrors the results of three separate CEA consumer studies conducted over the past several years and is further supported by hard subscriber data from the National Cable Television Association, Echostar, and DirecTV," wrote Shapiro. "Similar results have been reached by others including the Federal Communications Commission, Nielsen Media Research and the Analysis Group."

Converter Boxes for the Transition

In July 05, the Association for Maximum Service Television Stations (MSTV) and the NAB announced a program to develop a prototype of a terrestrial digital converter box (TDCB) to convert broadcasters' ATSC VSB digital transmissions and MPEG coding to the NTSC format. The following features were listed as design goals for the TDCB:

Inexpensive, does not compromise over-the-air performance;
Processes all ATSC video formats;
Delivers video and stereo audio to NTSC receivers on either TV Ch. 3 or 4, along with a base-band composite video output with stereo audio;
Must have robust front-end performance, including multi-path & overload immunity;
Small and lightweight;
Easy to install and operate;
Transparent to the user;
Be PSIP-compliant and have a friendly menu guide;
Comply with closed captioning, EAS, and the required parental controls;
Include a detachable antenna and a smart external antenna interface;
Be operable by remote control.
Responses are due by noon on July 22.
A working prototype is expected by the end of the year.

Note that the outputs expected on the design of the STB above are only 480i over RF or composite video, which means that if this design is the one to be used for the final boxes of the subsidy plan ($40 vouchers) the resulting STB would "only" be useful for outputting NTSC level. The consumer would not be able to reuse it for HD with a future HDTV monitor, as all DTV OTA STBs do (NTSC output and HDTV output).

In September 05, LG, parent company of Zenith, chipmaker Zoran, Motorola, and Thomson successfully demonstrated on Capitol Hill prototypes of D-to-A technology connected to small indoor antennas and with side-by-side screens of analog and digital reception, including multicast channels.

LG demo was of a fifth-generation reception technology that handled well multipath interference at a place previous generations did not perform well.

LG showed a prototype of a finished product measuring 6.5-by-1.5-by-4.3 inch, weighting under 2 pounds, and using the 5G-plus technology above. According to LG, the D-to-A converter could retail for $50 by '08, assuming millions of units are ordered, but once a hard-date is set by Congress (which is set already, Feb 2009).

Integrated Tuner Mandate Update

In mid 2005, the FCC received the input from manufacturers, broadcasters, and industry trade groups regarding an FCC's tentative decision to accelerate tuner integration on all TV sizes from July 1, 2007 to December 31, 2006, advancing 6 months the current deadline, and also including sets under 13 inches (which was not within the current mandate).

Advancing the deadline was also viewed as a way to reduce the number of D/A converters that would be needed in the subsidy program when analog signals stop broadcasting.

The CEA also requested to "eliminate the July 1, 2005 deadline that requires manufacturers to make half of the 25-35 inches sets capable of receiving digital. Manufacturers had argued that the 50 percent deadline did not work because consumers would end up buying the cheaper analog sets, and retailers were less willing to order the more expensive, digital sets." The FCC rejected that request.

While Walt Disney, the NAB, and the Association for Maximum Service Television (MSTV) urged the FCC to adopt the advanced deadline of Dec 2006, the CEA, the CERC (Consumer Electronics Retailers' Association), Sharp Electronics, and Philips Electronics North America opposed and claimed not having enough time to manufacture those receivers by the end of 2006.

The CEA and CERC issued the following statements: "the FCC should refrain from making any rulings regarding the inclusion of digital tuners in new receivers with screen sizes less than 13 inches until manufacturers, retailers and the commission adequately are able to examine the impact of the small chassis products that currently are subject to the commission's tuner requirements." They opposed accelerating the timetable claiming that no evidence justified the change.

Other comments from the CEA regarding the effect on manufacturing and consumers of accelerating the mandate, were as follows:

"Some manufacturers could opt to market monitor-only models that remove both digital and analog tuners, or stop manufacturing certain sets altogether. For smaller sets, 13 to 26 inches, the requirement would double the development costs for manufacturers, as well as double the price of a typical 13-inch television to consumers," Shapiro said, and he added: "If the product is rejected by lower income

and other consumers because the price exceeds their budget, it will not be carried by retailers and, eventually, not produced by manufacturers."

Shapiro said the "the unfortunate result of accelerating the tuner mandate deadlines for all sets would be to decrease the number of DTV tuners in the marketplace, which clearly does not serve the transition."

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:

Currently for >=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.

H/DTV Programming

On past CES reports, I dedicated a section to the details of this subject. Now there are a good number of H/DTV channels to motivate DTV adoption based on content not just technology. Additionally, such information is now readily available from a variety of sources. The original purpose of this section has ceased to exist, so is discontinued.

DTV Market Penetration

Please refer to the previous CES reports that explain how the market of DTV evolved since its introduction in November 1998.

The CEA publishes statistics about market penetration of DTV, and breaks down the statistics by type of technology.
In global DTV terms, the CEA provided the following numbers (as of January 06):

Unit Sales to Dealers
2001: 1.4 million
2002: 2.5 million
2003: 4.1 million
2004: 8.2 million
2005: 12.3 million (estimated)
2006: 18.7 million (projected)

Plasma sales jumped from 0.8 to 1.9 million from 2004 to 2005, projected to jump again to 2.9 million for 2006.

LCD TV sales jumped from 1.8 to 4 million from 2004 to 2005, projected to jump again to 7.1 million for 2006.

Digital projection RPTV sales went down from 3.5 to 3.1 million from 2004 to 2005, projected to go further down to 2.7 for 2006. This RPTV group includes CRT, LCD, DLP, and LCoS RPTVs.

For the RPTV type of display the 2004 3.5 million above was the peak year (2003 was 2.4, but 2005 went down to 3.1). The growing adoption of panels seems an important factor for that, which growth more than doubles up every year, and with panel projected prices to further come down the effect could be accentuated soon.

Regarding the exiting technology of analog TV for NTSC, sales of CRT projection analog TV showed a downturn from 97,000 to 20,000 from 2004 to 2005, and is projected to go down even further to 5,000 in 2006.

Analysis, Projections

A 50% increase of overall DTV unit sales is expected for 2006, similarly to the 50% for the previous period (2005 over the 2004). However, I was expecting more unit sales, and for percentage of growth to be even higher for 2005 and 2006, because today's DTV buyers are not the smaller group of technology-oriented early adopters, but rather a much larger mass of consumers buying for TV viewing objectives.

On the first years of DTV, several millions of early adopters provided a jump-start and paid very high prices to experiment with the technology. Every year they almost doubled up the unit sales. In 2005, the "percent" of market penetration has actually slowed down from 100% (03-04) growth to 50% growth (04-05).

At about the year 2003, the typical DTV consumer changed from the technology-early-adopter type, to people interested on viewing TV on a better set, and got motivated because prices were down sufficiently to meet their budgets, in addition to the unique market conditions created by enchanting panels.

Relative to the total 285 million U.S. "TV sets" inventory, we are still at an early point of market penetration, having only reached 10% with only 28.7 million of the TVs been "replaced" in the period 1998-2005. However, relative to an implicit objective of having at least one TV on each household with DTV capabilities for emergency communication purposes, the percentage raises to 26% (28.7 million of 109.7 million "TV households"), assuming those DTVs were purchased by different households, which most likely is the case for the majority of them.

Let us look briefly at a possible projection (to my knowledge, the CEA has not published a projection for 2007 and 2008). Those two years complete the transition before the 2009 deadline. I would use CEA's projection of 50% for 2006, and the actual 50% growth of 2005.

Applying a similar 50% growth for the years 2007 and 2008, the projections would be 28 million for 2007 (18.7 million of 2006 x 1.5), and 42 million for 2008 (28 million of 2007 x 1.5). Considering that by the end of 2006 the CEA projects a cumulative 47.4 million DTVs sold to dealers, if we add to that the 28 million from 2007 and the 42 million from 2008, the total unit sales would be 117.4 million since

DTV was implemented in 1998 until the end of 2008, 1 month before the DTV transition is due.

As mentioned before, based on the Nielsen Media Research data, 285 million sets are used in the country, of which 109.7 million are U.S. television households, each owning an average of 2.6 TVs. The report also indicated that a good number of those 2.6 sets are used for stand-alone applications such as gaming, DVD viewing, etc.

The transition effort of implementing DTV sets based on my projection of 117.4 million would then reach 41% market penetration of the current inventory of 285 million TVs by February 17, 2009. Even when the other 167.6 million analog TVs are not replaced by DTVs before 2009, the 117.4 million would still be enough for each household (109.7 million) to have at least one DTV by the time the new DTV transition deadline is due in 2009.

However, take into consideration that because the DTV technology is setting its footing, not like the 285 million analog TVs of a 50 year old NTSC standard, it is not easy to predict the manner those 117.4 projected DTVs would be distributed among the 109.7 households. The distribution most probably would not be perfect as 1 DTV per household, but not the 2.6 ratio per household either, in other words there would be millions of households that by 2009 would not have a DTV as the main viewing set.

From another angle, considering that 86% of U.S. households are satellite and cable subscribers, those households would probably have their secondary TVs connected to a STB that is already doing the tuning and conversion to 480i analog. Many of those might actually be used for tune-less standalone applications such as video gaming and DVDs. Therefore, the pending 167.6 million analog sets might not be an obstacle for interrupting analog broadcast in 2009.

On looking at the specific scenario of the 32.7 million broadcast viewers, those unable to upgrade to an integrated-DTV by 2009 could make good use of the subsidy coupons for two OTA-tuner STBs so they can continue viewing digital content on their analog TVs. However, they would have to pay full price for each additional OTA STB needed for other TVs used for broadcast reception, if any, at that time the investment could possibly be about $50 per STB as industry leaders project with volume.

Cable companies were not authorized their request to down-convert digital channels at their head-point to continue distributing the channels as 480i-analog to analog subscription households. In other words, a digital channel has to be distributed as digital and if there is a need for a digital-to-analog conversion, it has to be done at the viewer's home, so the content could still be viewed on legacy NTSC analog sets.

On that scenario, a cable company would have to supply a digital-to-analog box to replace old analog STBs that are still in use, although many subscribers might have the cable coax connected directly to their cable ready TVs (no STB). Some have estimated that number to be about 40-50 million TV households. The cable company and analog subscribers would have to foot the extra cost related to the digital STB/installation, and the monthly fee for switching to a digital tier service, in some cases about $10 per month.

DTV Standards - Update

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.

ACAP Standard

In September 2005, it was announced that the ATSC approved the Advanced Common Application Platform (ACAP) standard. ACAP is said "to provide content creators, broadcasters, cable operators and consumer electronics manufacturers with the technical details necessary for the development of interoperable services and products, and harmonizes the ATSC DTV Application Software Environment (DASE) Standard with CableLabs' OCAP specifications", according to ATSC president Mark Richer.

According to the ATSC, the ACAP together with a previously published Standard A/96, "Interaction Channel Protocols", provide a complete interactive system when used in combination with forward broadcast download channels from terrestrial, cable, and satellite networks. Both the ACAP (A/101) and the Interaction Channel Protocols (A/96) documents are available at www.atsc.org/standards.html

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

High-Definition Audio-Video Network Alliance (HANA)

HANA was created in late 2005 by a group of electronics manufacturers and media companies to develop guidelines for secure HD audio-visual networks. The founding members include Charter Communications, JVC, Mitsubishi Digital Electronics America, NBC Universal, Samsung, and Sun Microsystems.

Additionally, ARM, Freescale Semiconductor, and Pulse~LINK have joined HANA as contributing members. The Alliance is consulting with organizations such as CEA,

CableLabs, the Motion Picture Association of America (MPAA), the ATSC, and the 1394 Trade Association.

According to the Alliance, the guidelines would enable new products slated for release by CES 2007 to be compatible among manufacturers, and will use existing technology and specifications to enable consumers to:

View, pause, and record five or more HD channels simultaneously without compromising quality of service;
View, pause, and record HD anywhere in the home with just one set-top box;
Share personal content from PCs to AV devices while keeping protected content secure;
Control all AV devices and access content with just a single remote per room; and
Add any device to the home network with just one cable.

For more information, visit www.HANAalliance.org.

Satellite

During 2005, DirecTV and Dish Network continued the expansion plans highlighted in last year's report. The plans include the launching of more satellites, the MGEG-4 implementation, more HD channels (mainly HD OTA feeds for local markets), MPEG-4 equipment introduction, and customer STB replacement programs.

Regarding customer base issues, the companies continuously adjust their offerings of upgrade programs to meet market conditions, providing incentives, rebates, etc., it is not the objective of this section to detail a complete inventory of how those programs evolved with time. The pricing requirements of the upgrade programs were different if a subscriber wanted to upgrade earlier, in other words by the time you read this the conditions would have changed already.

For several years CE manufacturers competed for the market of satellite STBs, a prospective buyer could find STBs with different features, user interface, performance, etc. That market competition has been reduced considerably when DIRECTV decided to control their STB distribution.

DIRECTV

The Planned Upgrade

In September 2004, DIRECTV announced their plan to launch fourth generation satellites to expand HD and interactive services. The first two new Ka-band satellites, the Spaceway 1 and 2, were to be launched in 2Q2005 and programming offered by the middle of the year including local HD to most of the US to a capacity of 500 channels, and expanding SD services. The launching would enable the offering of local HD channels initially to 12 markets.

The next two Ka-band satellites DIRECTV 10 and 11 will launch early in 2007 and will expand the capacity to over 1000 additional local HD channels and more than 150 national HD channels, among other offerings to consumers with a single small dish.

DIRECTV planed to implement MPEG-4 AVC in late 2005, with a new dish capable to receive signals with five LNBs. When the plan was introduced, no confirmation was provided regarding how the upgrade path to existing customers will be carried out, however, later DIRECTV officially released better detail for customer upgrades to new MPEG-4 capable HD-STBs, confirmed at CES as well.

In January 2005, DIRECTV also announced that there will be new interactive services with a mix of regular channels with enhanced features, such as six channels simultaneous viewing, new DVR's and service, and the introduction of a Home Media Center later in 2005 (although not HD level).

2005/6 Update

As of October 2005, the company has been reported to have over 15 million subscribers.

In November 2005, DIRECTV Group Inc. announced that it would sell for $100 million the remaining of Hughes Network Systems Inc. to become a wholly owned subsidiary of SkyTerra Communications Inc., controlled by Apollo Management LP. SkyTerra already bought the first half of Hughes in April for $50 million. The plans were to continue with its existing 1500 employees as well as with the senior management team.

By November 05, DIRECTV declared that Detroit was receiving local HD channels by October 20, and Chicago, Philadelphia, Atlanta, and San Francisco were expected to have access to Local HD channels via DIRECTV in November. The plan was that in December the cities of Tampa, Dallas, Houston, Boston, Washington D.C., Los Angeles, and New York would receive HD locals as well.

Thirty-six DirecTV major markets will be serviced by April 2006. The company launched the Boeing's Spaceway F2 satellite, which together with the Boeing's Spaceway F1 (identical spacecraft launched earlier in 2005), would provide 500 local HD channels to all those 36 markets, estimated to be about 57% of TV households, covering 12 cities by year-end 2005, and the remaining 24 early 2006.

As planned, in 2007 two more next-generation satellites will be launched to complete 1500 local and 150 national HD channels.

A new MPEG-4 HD-STB with DVR was shown at CES, please consult details at the HD STB section.

Samsung announced at CES a $500 10 inch LCD display that would contain a DIRECTV tuner named "FlipTop" to be released by March 06 by both companies under their names.

The combo is planned for kitchen, office, etc applications and can swivel with back light capabilities for under cabinet mounting, or be installed as table-top; it includes a 10-watt audio with stereo speakers, English/Spanish user interface, 3- device universal remote, 3-day Advanced Program Guide, A/V inputs, and a headphone jack.

DIRECTV announced in February 2006 their plans to launch a video on demand service later in 4Q06, which would provide access to 2000 shows and movies using a broadband Internet connection. No specifics were provided regarding HD content.

Dish Network

The Planned Upgrade

Dish Network announced in November 2004 that within one year the company planned to start the transition from their current MPEG-2 compression to MPEG-4, which would allow for more channels (regular and HD). The upgrade would require

replacement of current MPEG-2 HD-STBs, incompatible with MPEG-4, the new STBs would handle MPEG-4 and decode MPEG-2 signals.

The transition was viewed as possibly taking 4 years to complete, starting with the existing HD subscribers. During that time there will be dual services of MPEG-2 and MPEG-4, and was anticipated that there will be no cost to customers with older boxes.

Voom

The company was acquired by Dish Network beginning 2005, which is now offering the HD Voom channels within the Dish Network services.

2005/6 Update

Dish Network has reached 12 million-subscribers by year-end 2005.

Dish Network continued with the addition of other Voom HD channels. The company is going to raise the 10 channels to reach 25 in total; some of those HD channels were announced to become available in the near-future plans for 2006. ESPN2, Universal, Food, and HGTV HD channel versions were mentioned.

In February, the company is launching local HD channels in the markets of New York, Los Angeles, Chicago, and Boston using MPEG-4 compression technology. By the end of 2006, the company expects 50% of households to be serviced.

A few new HD-STBs were introduced at the CES 2006 show, the VIP 211 for single room SD/HD, the VR-222 for multi-room HD main, SD 2nd room, and the VIP 622 dual tuner multi-room capable DVR with 320GB for 180 hrs of HD. The MPEG-4 STBs will be released in March/April 2006. The company has implemented newer encryption, compression, and modulation systems.

1080p outputs on Dish Network STBs are not expected for 2006, but there was a comment that perhaps they will, for later in the future.

Dish Network announced at CES 2006 that they have added new HD channels in MPEG-4, which only MPEG-4 capable HD-STBs would be able to tune.

In February 16 06, EchoStar satellite X launched successfully, the satellite will operate from 100 degrees west and has an expected life of 15 years.

Cable

For over the past three years (and probably for at least one more year), QAM CableCARD tuners within integrated HDTVs were released with only unidirectional features, lacking the interactive ability for VOD, impulse PPV, and cable-provided EPG.

However, on January 2005, Samsung made an agreement with three MSOs that serve over 20 million subscribers, Time Warner Cable, Brighthouse Cable, and

Charter Cable. Under the terms, there will be an implementation of bi-directional OCAP software on Cable tuners, with a middle-ware specification designed with a universal interface.

OCAP is part of an industry agreement that is several years old and was formally known as PHILA (POD Host Interface Licensing Agreement). Later, with the arrival of the CableCARD concept, the name was changed to CHILA (the front "C' from CableCARD).

Managing the Progress to Bidirectional

The FCC delayed until July 2007 the July 2006 deadline on the ban on all-in-one security/navigation devices to provide enough time for operators to complete a downloadable security software solution.

Additionally the FCC established a policy of 60-day status reports starting October 1, 2005, for the National Cable & Telecommunications Association and the CEA to report the progress regarding availability of retail equipment to eliminate bi-directional cable STBs.

Likewise, Comcast, Time Warner, Cox, Charter, Adelphia, and Cablevision were to report every 90 days regarding the availability of software to allow activation of a CableCARD's suited STB cable subscribers would buy at retail (cable operators must supply the CableCARD).

Microsoft and CableCARDs?

In November 2005, to extend the support implemented last fall for HD OTA reception on PCs, Microsoft made an agreement with the cable television industry to work with CableLabs to make windows PCs suited with Media Center able to display cable SD and HD programming, with a signal protection mechanism and without using a HD-STB by late 2006. PCs will have a CableCARD slot, which, and as with the other CableCARD implementations, it would only offer unidirectional capabilities (OCUR, Open Cable Unidirectional Receiver).

Unidirectional CableCARD in a Bidirectional Cable World

Was unidirectional CableCARD ever alive? Perhaps it should have never been implemented with only unidirectional functionality knowing that the bidirectional solution would have no backward reusability of millions of integrated CableCARDS tuners in HDTVs sold over the past 3 years. Perhaps without the idea of CableCARD integrated TV tuners the cable industry would not have jumped into the HDTV bandwagon as they did.

Is difficult to determine what would have been better to the consumer, a slower DTV transition while cable continued sitting on the side disinterested in HDTV, or consumers buying TVs with the extra cost of CableCARD tuners destined to be replaced shortly.

Ironically, when many could tend to think that the cable companies were behind this, actually the unidirectional CableCARD approach was soon noticed by cable companies as a loss of revenue. Subscribers stopped leasing bidirectional STBs, and with it gone was the opportunity of the cable company to make a profit with impulse PPV and VOD as friendly as clicking the remote control, because CableCARD did not allow it. CableCARD was also a loss of money for those consumers that needed PPV and VOD; they ended up paying for a cable STB and HD wires, in addition of paying extra for the integrated CableCARD tuners on their new HDTV.

The replacement to the unidirectional CableCARD is warming up. Is it CableCARD II? iDCR?, Plug-and-Play II?, OCAP?, DCAS?, ETV? Perhaps all of the above.

iDCR and DCAS

In December 05, responding to FCC requests to develop a system with bi-directional features, the cable industry introduced a proposal to implement iDCR (Interactive Digital Cable Ready) within DTVs and other equipment without using a separate HD-STB for the bi-directional features.

Instead of using a CableCARD, the iDCR uses the DCAS system (Downloadable Conditional Access System) to provide the ability to download the cable company's security system and the conditional access codes to that cable operator's device. It is said to be less expensive to implement than CableCARDs.

Samsung and CableLabs have signed an agreement to be the first CE manufacturer to implement DCAS on their products.

OCAP

OCAP (Open Cable Application Platform) is like an operating system for a cable device (HDTV, STB, etc). It is a middleware that provides a platform for bi-directional cable functionality without the need of a Cable CARD, which again, was only unidirectional and lacked support for VOD, impulse PPV, and cable supplied EPG.

With OCAP, cable services would be able to be sold at retail and be transportable across cable providers, the EPG would be nationally portable, a test with several cable service providers was made in August 2005 to demonstrate the transportability of the EPG when running over OCAP middleware on nationally portable hardware.

A gradual deployment of the OCAP middleware of the iDCR is expected to start in October 2006, and according to the plan, cable subscribers of a company that implemented OCAP could start requesting two-way access on April 2007. By July 2008, operators with over 2 million subscribers must be OCAP capable. Operators over 5 million subscribers must implement OCAP by July 2009.

OCAP Implementations

Panasonic announced their efforts on building HD-STBs supporting OCAP middleware that will have 250GB of DVR storage capability, double of current Comcast DVRs, and will be suited with CableCARD slots, MPG-2, H.264 decoding capabilities, USB 2.0 for

connecting digital cameras and music players, and designed for the Downloadable Conditional Access System (DCAS).

Samsung announced a similar support as Panasonic regarding OCAP middleware, with a an agreement they did with Comcast to supply 200,000 HD H264, MPEG-2, and MPEG-4 capable cable set-top-boxes starting in 2007 using such software capability, which could be raised to 500,000. The "RNG" series boxes will also have DOCSIS 2.0 and USB 2.0 for interactivity.

Samsung also indicated that they were using interactive OCAP digital cable services with Digital Navigator in some of their sets supporting Time Warner Cable services in Gastonia, NC.

Samsung is delivering in October 2006 an OCAP suited 56" DLP HDTV that has been certified on August 2005 by CableLabs, LG stated that 2007 is most probably when they will have a product, and the group believes that OCAP services and products will be delivered in the 2007/8 time frame.

ETV

ETV (Enhanced TV), a subset of OCAP, was also tested at the interoperability OCAP testing event above. CableLabs released the ETV application messaging specification in 2005 to enable applications to include images, triggers, program links, etc. embedded into the digital video stream.

Broadcasting

By August 2004, the FCC reported that has already approved 13 different "digital output technologies and recording methods" to implement the Broadcast Flag order. A complete detail of the subject of Broadcast Flag is covered in the Content Protection section.

In May 2005, a Federal Court of Appeals in Washington rejected 3-0 the regulation of the Broadcast Flag implemented by the FCC, stating that the commission did not have authority to enforce such ruling, unless Congress enacted a law. Please consult further details within the section of Content Protection.

On July 2005, the FCC announced that has increased regulatory fees between 2.6 and 14 percent to terrestrial stations, under Congress mandate, to cover FCC's associated activities. DTV only stations are exempt from that fee.

Must-Carry Multicasting Channels

In December 2004, the FCC has confirmed their earlier opposition regarding forcing cable operators to carry any other broadcasted digital multicast sub-channel other than the primary.

The issue was brought by some broadcasters (including Paxon) to the United States Court of Appeals for the District of Colombia Circuit because they wanted cable

operators to carry all of their multicast channels. As mentioned earlier, as of February 2006, no ruling has been issued to mandate must-carry to cable operators.

USDTV

As described on the section of broadcasting of last year's report, the USDTV service is offered for about $20 per month and delivers approximately 30 channels OTA which could be tuned through a VHF/UHF antenna using an USDTV HD-STB (details also on that report).

The service is being tested in three pilot markets: Salt Lake City, Albuquerque, and Las Vegas.

USDTV announced at CES 2006 their plan to deploy HD-STBs by spring in the Norfolk, VA area, with a service of more than 30 all-digital channels of local stations and cable networks, such as Discovery, ESPN, Disney, and Fox News channel for $19.95 per month, with a two year no-increase guarantee. The Starz channel was also offered for $6.95 a month. The Norfolk introduction would be the fifth market for the USDTV service (the first on east coast).

In October 2005, USDTV announced a $25.75 million funding deal with Fox Television Stations, Hearst-Argyle Television, McGraw-Hill Broadcasting, LIN TV, Morgan Murphy Stations, and Telcom DTV to fund their expansion.

CRT, SED, OLED, FED, NED

Definitions included within each manufacturer

Applied Nanotech

The Texan company has created a 25-inch prototype TV based on carbon nanotubes, claimed to be brighter and crisper than today's TV sets. Canon, Toshiba, and Samsung, among others, were testing this slim technology over the last few years.

According with the company, field emission display (FED) TVs, electrons get filtered into an array of thousands of tips only a few nanometers wide, which then deliver electrons to illuminate the screen. Panels using this technology could be as slim as LCDs or plasmas.

Canon

The company demonstrated their SED technology (in partnership with Toshiba), on the right is the 37" prototype panel shown at CES. Canon said that the first unit will be a 55" 1080p model (which will become available in Japan next year), they do not know price, nor date of availability yet, only size. It will have a life cycle of about 30,000 hrs (similar to CRT they said). Canon and Toshiba will be selling similar models under their brand names.

GTT

FP CRT

Dec 05

GTT HT Reference 9 projector, 9" CRT, offered as a $48,000 package paired w/Faroudja DVP-1500 DVD player/scaler, Stewart Studiotek 130 screen, setup, and ISF calibration, 2500x2048 resolution, RGBHV input

JVC

CRT direct-view

30" AV-30W777, $800, TTM Jun 06, 1080i, ATSC/QAM/NTSC tuners, HDMI, 2 component, optical audio output

Hitachi

May 05

CRT RPTV
New lines with reduced cabinet depth, ATSC tuners, CableCARD slots, HDMI inputs, Day and Night Memory by Input with Timer, Quick Start Seamless HDTV and NTSC Tuners, Magic Focus® Auto Convergence (with 9-point manual convergence and 117-point fine tuning convergence), High-Contrast 0.52mm Fine Pitch Screen, and a 4:3 Expanded Mode that offers users a range of options for watching traditional 4:3 programs on the new 16:9 widescreen televisions.

F710A series
Open distribution, TTM Aug 05
51" 51F710A $2,000
57" 57F710A $2,400
65" 65F710A $2,700

S825 series
National and regional TV/appliance line, TTM Sep 05
Same features as above plus illuminated roll and click remote, a Super Contrast 5-Element Lens System for 72 percent better focus at picture edges than traditional lens designs and 54 percent more contrast, Super Contrast II CRT technology for brighter and more accurate picture performance, UltraVision® industrial design – a modern, satin silver profile.
51" 51S825 $2,100
57" 57S825 $2,300

Aspect line
Monitor only line offered to mass merchants and warehouse club accounts that have not been part of Hitachi's traditional distribution.
55"
61"

2006 line additions
CRT RPTVs
1080i, ATSC/NTSC tuners, Magic Focus Auto Convergence System, HDMI, 0.52mm fine pitch Screen, six Aspect Mode choices for 4:3 expansions to 16:9.
51" 51F59 $1,300, TTM Apr 06
57" 57F59 $1,500, TTM May 06
65" 65F59 $1,800, TTM May 06

LG
The company abandoned CRT tube TV in Europe (Oct 05), to concentrate in thin TVs. CRT market in Europe was expected to drop 20%, double LG expectations beginning 2005.
CRT direct-view
30" $900, flat-faced, ATSC tuner, NO CableCARD, TTM March 06, HDMI, RGB, 1080i

Mitsubishi
OLED
Dec 05
The company announced their development of new blue phosphorescence Organic Light-Emitting Diode (OLED) material which has four times greater luminous efficiency than currently used fluorescent material, and can be manufactured at

lower cost than other OLED processes; it uses a wet-coating process, and could be applied for large panels.

OLED devices emit light when an electric current is applied and do not require a backlight to function. They consume less power, have a wider viewing angle, and display a brighter image with a refresh rate that is a thousand times faster than LCDs.

According to Mitsubishi, the new OLED device also employs hole blocking material and hole injection material to achieve 30cd/A efficiency at an intensity of 100 cd/m2 (external quantum efficiency: 13 percent), more than twice that of conventional blue wet-coating type OLEDs.

Motorola

NED

On May 05, Motorola introduced its first working nano-emissive display (NED) prototype (five-inch diagonal proto-television) at the Society for Information Display (SID) conference in Boston. The wafer-thin display is one-eighth of an inch thick. If enough interest from large companies is reached manufacturing could be by 2007, and prices could be under $1000 (Display Search, estimated that a 40-inch NED display could retail for $800 or less).

According to some NED industry analysts, NED uses millions of accelerated electrons charged by just 5 to 10 volts of electricity, compared with 5,000 volts for large-screen, high-def LCDs. The electrons shoot toward a phosphor plate, creating the moving image. This technique requires less voltage than a CRT. Unlike LCD, a nano-emissive display, which uses carbon nanotube technology, will be easily viewable from all angles.

Don Bartell, a product director at Motorola, stated that a critical benefit of NED over other display technologies is no limit to the display size. NED could be used by ad agencies erecting monolithic 100-inch roadside billboards and consumers wanting a 42-inch home entertainment centerpiece.

Philips

CRT direct-view

Nine models for 2006 in the Magnavox (13” and larger) and Philips brands, TTM Mar 05, ATSC tuners on 27” and larger, Real Flat picture tubes.

20”
27”
30”
32”

RCA (please refer to Thomson)

Samsung

OLED

The company has an OLED prototype 40-inch panel made from a single-sheet organic light-emitting diode (OLED) that consumes less power than traditional flat

panels and do not require a backlight, with higher resolution than LCDs. OLED has been implemented in phones and other devices with small screens, but Samsung has implemented it also on larger prototypes, such as a 14.1-inch OLED panel 1280x768 and a 21" HD 1920x1080. The 40" is a 1280x800, brightness of 600 nits, contrast ratio of 5,000 to 1, 2.2 centimeters thick panel to fit TVs under 3 centimeters deep.

FED

OLED is joined by field emission display (FED) televisions where thousands of carbon nanotubes, or other components, shoot electrons at a screen to create a picture; FED televisions are expected to be thinner than current flat-panel televisions and provide better resolution. A prototype has been developed by Samsung from a sheet of 730x920 millimeters of mother-glass using amorphous silicon processes, as with LCDs.

CRT

Space-saving CRP (Cathode Ray Panel) technology

30" TX-R3079WH, $1100, TTM now, 16" depth, ATSC tuner, flat tube, incorporates progressive scan DVD (480p) compatibility and 3:2 Pull Down processing, Digital Natural Image Engine (DNIe™) picture enhancement technology, powerful side-panel stereo speaker system, HDMI.

30" TX-R3080WH, $1,100, TTM now, sleek cabinet with a bottom built-in stereo speaker system and is available only at selected high-end outlets.

Nano-pigment screen design for 5000:1 contrast ratio. Accepts 720p and 1080i, delivers a progressive image, Dolby Digital Dynamic Sound System™ with a 20-watt stereo with a multi band adjustable equalizer.

CES

CRT Slim Fit with only 16" depth, ATSC/NTSC tuners, 3-2 pulldown.
30" TX-S3082WH $1,000, TTM Mar 06, HDMI
30" TX-S3080WH $1,000, TTM Mar 06, HDMI
27" TX-S2782H $700, TTM Apr 06, 2 HDMI, 2 component
27" TX-S2783 $500, TTM Apr 06, SD 480i analog, component 480i DVD input
Samsung will discontinue 32" flat-screen CRT in 2006 to concentrate in Slim-Fit models.

Thomson (RCA)

The company decided to eliminate IEEE1394 and CableCARD on 2006 models to reduce costs.

CRT RPTV

Eight new models for June 2006, DVI, component, 480p/1080i
52" R52WH73/74 $1,150
52" R52WH76/78 $1,200
56" R56WH76/78 $1,400
61" R61WH76/78 $1,500

CRT Direct-view 4:3
SDTV 480i, 8 new sets, curve & flat tubes, ATSC tuner, TTM Mar 06 for most models.
27" 5 models from $369 to $459 (27V414T, 514T, 524T, 525T, 534T)
32" 3 models from $549 to $679 (32V434T, 524T, 654T)

HDTV, 16:9, 1080i, integrated ATSC tuner.
26" HD26W854T $629, TTM June 06, 16:9 AR
27" HD27F754T $549, TTM Mar 06, 4:3 AR

Toshiba
Jun 2005 line show
CRT line
Fifteen direct-view CRT models, six of which are high definition, the HD line will be widescreen monitor-only pieces.

TheaterWide
26" 26HF85 $600
30" 30HF85 $900
34" 34HF85 $1200
Cinema Series
TTM Sep 05
30" $1,000
34" $1,300

27" 27AF45 $330
32" 32AF45 $500

CRT RPTV
Custom Series
Priced for mass sales. To get around the FCC's DTV tuner mandate, Toshiba is omitting NTSC analog tuners from two models:
51" 51HC85 $1,300, HDMI
57" 57HC85 $1,500, IEEE1394, HDMI
TheaterWide
Digital-cable-ready
57" $1,900

CES

The company decided to use the CES show to make announcements that usually happen at their dealer show in spring. The company is investing in LCD and SED in 2006, while also carrying plasma as a mainstream product. Toshiba is abandoning the CRT RPTV line this year.

CRTs direct-view
Eight models for 1Q06, all with integrated NTSC/ATSC/QAM on-the-clear tuners

HDTV line
1080i native, two models with FST Pure widescreen, HDMI/HDCP, 2 Colorstream component analog input.
26" 26HF66
30" 30HF66
Standard Definition line
480i, FST Pure, ColorStream inputs, silver/gray bezel design
26" 26DF56 widescreen
30" 30DF56 widescreen
27" 27DF46 flat-tube 4:3
32" 32DF46 flat-tube 4:3

Two other curved picture tubes with 480i, Colorstream inputs, silver cabinets, and dark-gray cosmetics:
27" 27D46
32" 32D46

SED line
TTM late 06
36" demo at CES, 1920x1080
50"+ screen sizes commented

SED
Toshiba and Canon have been working together since 1999 in a join venture for the development of SED panels, expected to be 55 inches and above. Flat panel TV with SED (surface-conduction electron-emitter display) technology is said to be similar than CRT beam-emitting technology to obtain comparable clear images but with a flat panel. SED handles fast images without jagged edges and consumes one-third the electric current needed by plasma.

SED is formed by two glass plates with vacuum in between, one mounted with electron emitters and pixels similar in number to those of a CRT electron gun, and another glass plate coated with a fluorescent substance. The technology has a very narrow slit (several nanometers wide) made from ultrafine-particle film; reaction to voltage produces a tunneling effect and the emission of electrons, which are accelerated by the voltage applied between the glass plates and collide with the fluorescent-coated glass plate, which emits light.

SED has a wide angle of viewing, similar to CRT. Larger screens can be manufactured increasing the number of electron emitters to match the required number of pixels. SEDs do not need electronic-beam deflection. Wall-mounted large-screen TV displays can be made with only a few centimeters thick.

SED products are expected to perform with 1 millisecond response time and 8600:1 CR, and were planned to be offered at a price range of LCD-TV panels of equivalent size, starting with 50" model. The company expects SED panels to challenge the flat-panel market currently dominated by plasmas and LCD-TVs.

Although the first SED televisions were said that could be available in 2005 and full production was expected in 2006, Canon just stated at CES that Japan expects the first model to become available for next year. However, 10 months remain to finish 2006, plans of availability of SED could change under the pressure of plasma and LCD panels.

Digital Light Processing (DLP)

According to market-watcher Pacific Media Associates (PMA), DLP technology holds 69.8% of the consumer front projection market in the U.S. as of 2Q05. The addition of DLP 1080p chipsets will allow customers to offer maximum-HD for front projection. According to Texas Instruments (TI) they hold 95% of the market on technology over $5,000 (*which leaves out of the statistical set most LCD RPTV and FP units because they are usually less than $5,000, and LCoS is just warming up*).

Manufacturers who will be announcing front projection products based on DLP 1080p technology in the near future include: Barco, Christie Digital, Digital Projection International, DWIN, InFocus, Marantz, Mitsubishi, Panasonic, ProjectionDesign, Optoma, Runco, Samsung, Sharp, SIM2 and Yamaha.

TI announced increased color performance available for DLP front projection single-chip products with BrilliantColor™ technology. With up to 6-color processing, which moves significantly beyond other technologies' limitations of 1-color-per-chip processing, BrilliantColor™ technology will enable a greater than 50% brightness increase in mid tone images, common in video and natural scenes, translating into truer, more vibrant colors, TI said.

"We aim to meet both the needs of our customers and the needs of the market, and adding DLP 1080p technology to our offering will allow our customers to round out their product lines and fill a specific market need," said Lars Yoder, Business Manager, TI's DLP Front Projection Products. "Consumers will benefit from products with maximum HD resolution that will provide incredible detail of the images and deliver a truly amazing viewing experience."

"We are very excited about the addition of DLP 1080p 3-chip technology to our product offering," said Nancy Fares, Business Manager, DLP Cinema Products. "This allows our partners to offer flagship products with an exceptional image to the high-end theater enthusiasts."

TI also announced that they will ship the first commercially available DLP HDTV with an LED light engine in 2006 to offer the ability to display a wider color gamut of 130%, and instant on/off functionality, color refresh rate to 48x the standard TV frame rate, Samsung expects to start shipping sets with this technology by mid-2006.

TI introduced two new chip sets: the .45" 720p DLP chip and the .65" 1080p chip.

For details about features on previously released DMDs and "wobulation" please consult the 2005 report.

Akai
RPTV
3-RGB LED based 1080p DLPs
20,000 hrs – 50,000 hrs, fast turn on time
46" PT46DV27L $1,800, TTM Mar 06
52" PT52DL27L $2,200, TTM May 06

Barco
RLM H5 Performer $22,350, 720p, 4500 ANSI, 1000:1 CR

BenQ
FP, current models, all specs on 2005 report
PE 7700 $3,300, 720p
PE 8720
PE 8260

Christie
Roadie 25K, 2048x1080, 1500:1 CR, 25000 ANSI, 2:1 AR

Digital Projection Inc
FP
dVision HD 720p $17,000, two 250watt lamps, 2500 lumens, DarkChip3 DMD, 1600x1200 computer input, 120kHz horizontal, 2000 hrs lamp life, 6000:1 CR, VGA 15 pin, DVI-D digital RGB, BNC RGBHV, component.

iVision HD-7 720p, 2nd generation, 1000 ANSI lumens, 3000:1 CR, 1.75-2.25:1 zoom lens.

Dwin
Current models, consult the CES 2005 report.

Hitachi
Sep 05
FP
1080p chip, DLP 1080p resolution chips will be made available to customers for both single-chip and 3-chip applications.

HP
RPTV
1080p line
xHD4 wobulated chip, DynamicBlack aperture, 7-segment color wheel, 10 inputs, 1080p/24/30/60 fps input on HDMI, component input capable of accepting 1080p/24/30fps, built-in digital media receiver to communicate with home networks (wired and wireless), 12000:1 CR
58" md5880n
65" md6580n $5,000, TTM now (on right)

In 2006 the above sets will have a facelift with a new glossy black finish, TTM summer 06:

720p line
50" md5020, 2200:1 CR
58" md5820, 2200:1 CR

2006 line
HP Visual Fidelity technologies w/patented wobulation, CableCARD, TTM summer 06
1080p model with LED
52" ID5280n, super-bright LEDs that replace a traditional bulb and provide a broader range of colors as well as instant on/off.

720p
52" ID5220n

Infocus
FP
PlayBig line, TTM Feb 06
IN72 $1,200, 480p
IN74 $1,700, 576px1024
IN76 $3,000, 720p, CES demo did not impress me as advertised.

ScreenPlay 777, TTM now, 720p, details at CES 2005 report.

RPTV
ScreenPlay, 6.85" deep (specs on CES 2005 report).
50" 50md10
61" 61md10

LG
RPTV
62" 62SY2D $N/A, 1080p, CableCARD/ATSC tuners, HDMI, IEEE1394, RGB.

The company will release new 720p RPTV sets with Zenith brand:
ATSC/CableCARD tuners, TTM April 06
56" Z56DC1D $2,700, 2500:1 CR
62" Z62DC1D $3,000, 2500:1 CR

720p RPTVs continuing from 2005 line
52" 52SX4D, 1500:1 CR
62" 62SX4D, 1500:1 CR

FP
AN110, first wall mounted projector, 2500:1 CR, 1280x768 DMD, 1000 ANSI lumens, max 100 inches screen, 24 db noise level, HDMI.

Marantz
VP8600 $6,000, TTM now, for lower cost installations, HD2+ chip, 720p, 650 ANSI lumens, 4000hrs bulb life, 10-bit gamma processing, VGA, component, analog RGB, DVI/HDCP, 3:2 pull-down.

VP-12S4 $15,000, TTM now, 720p, upgraded version for image enhancement over current model done via firmware, uses Gennum GF9350 fully programmable architecture, details and specs at CES 2005 report.

VP-10S1 $38,000, TTM now, HD2 720p, below.

VP-11S1 1920x1080p new projector was shown as a prototype, 700 ANSI, 5000:1 CR, 2 HDMI, 2 component, Gennum video processing, $TBA (estimated between $15K-$20K), TTM mid-06 (right).

Mitsubishi
Announced Jun 05
<u>1080p sets</u>
All Mitsubishi 1080p models are able to receive MPEG 1080p 24fps signal via broadcast or IEEE-1394 input, according to the company.
<u>Nine models in five series</u>
Plush™ imaging, ClearThought™ technology, Dark Detailer™ light engine technology, Plush1080p™, Mitsubishi's third-generation upconversion system updated for 1080i-to-1080p deinterlacing. The 628 Series and 727 Series models feature Mitsubishi's new DeepField™ imager and SharpEdge™, enhancing brightness and contrast, 2 HDMI, 3 component, multi-format memory card reader, ATSC/CableCARD tuners, TV Guide On Screen® program guide, all-digital audio output that converts analog audio signals to digital, NetCommand® 5.0.

627 line
52” WD-52627 $3,700, TTM Jun 05
62” WD-62627 $4,500, TTM fall 05

628 line
Front panel IEEE1394 inputs with DV decoder to allow easy playback from digital video camcorders.
52” WD-52628 $4,000, TTM Aug 05
62” WD-62628 $4,700, TTM Aug 05

73” WD-73727 $5,800, TTM fall 05, powerful 150W lamp for a bold and bright picture, front panel IEEE1394 inputs with DV decoder to allow easy playback from digital video camcorders.

Diamond Series
827 line
MediaCommand, DeepField Imager, and removable anti-glare shields.
62” WD-62827 $5,800, TTM Sep 05, 160GB DVR
73” WD-73827 $7,500, TTM Sep 05
927 line
Accepts 1080p at 60Hz from VGA inputs (although I believe that spec was actually 24fps).
62” WD-62927, $6,300, TTM Sep 05 (below)

73” WD-73927 $8,000, TTM Sep 05, 250GB DVR for 25 hrs of HD, CableCARD, 2 HDMI, 2 HD tuners

Below is a description of some of Mitsubishi’s new technologies:

Dark Detailer™ is a new Mitsubishi technology that provides enhanced contrast and black levels. It allows a wider palette of dark gray shades, giving a realistic sense of depth to the picture.

DeepField™ imager is a new system Mitsubishi developed that allows the television to display enhanced contrast and sharpness. It constantly monitors the picture signal and finely adjusts brightness, contrast, and gamma so that every part of every frame is optimized. This results in a picture with greater depth-of-field, especially in scenes with both dark and light areas.

SharpEdge™ is the latest version of an exclusive Mitsubishi edge-definition system. New for this year, it enhances both horizontal and vertical edges for stunning picture precision.

FP
HC 3000U $3,000, TTM now, uses DDP3020 DLP TrueVision Image Processing, 1000 ANSI lumens, 4000:1 CR.
HC 2000 $11,000
HC 900U
HC 100U

In February 2006, Mitsubishi announced their use of laser as a source of light instead of mercury lamps used on projection sets. The use of laser offers a higher picture quality with greater color range according to the company. There was no announcement regarding availability or pricing.

NEC
HT410 and HT510 current models are on CES 2005 report.

LT30

Optoma
FP
Movie Time DV10, $1,500 (also seen as $1,300), TTM June 05, 854x480p, built-in, 5-watt high-fidelity speakers, DVD player, O2Air-Photocatalysis feature, ultra-violet light given off by the projector bulb to purify surrounding room air, kill airborne bacteria and molds, and break down smoke into carbon dioxide and deodorize the air; new “ImageAI” circuitry to adjust brightness intensity to produce both accurate bright images and deep black levels, new seven-segment color wheel which spins a 4x rate, short-throw lens (4.9 feet to 32.8 feet projection distance) to enable easy tabletop setup, image size can be adjusted from 36-inches to 335-inches, weighs 7.8 pounds, optical audio output, high-performance integrated speakers, optional subwoofer to match with the system, 92 “ image from 8 feet away, table position, 1.11x zoom lens, VGA (adapter for component), accepts 480i/720p/1080i, optical output for surround system.

H78 DC3 $4000, Sep 05, Darkchip3, 4000:1 CR, 880 lumens, 720p, DVI-I/HDCP, BNC-RGBHV, component.

H72 $2,000, TTM 2Q06, DarkChip2 DMD, 720p, 10-bit color, 7-segment color wheel, 4000:1 CR, 1300 lumens w/220w lamp, 3000 hrs lamp life, 10-bit color per-channel, 7-segment BrilliantColor color wheel, DVI-I/HDCP, RGBHV BNC, component, RS-232.

CES introduction
H81, $10,000, TTM 2Q06

Excellent demo of the H81 projector with Stewart Studio Tech HD130 of 135", **probably the best consumer FP 1080p picture at CES,** the image was very bright and according to Optoma a 1.0 gain screen is ideal, a Stewart screen was recommended, minimum distance of 15.6 feet from lens to screen, lens are positioned at angle with zero keystone designed for ceiling mount, 2000 hrs lamp ($400) for user replacement.

True 1080p singe chip, 6000:1 CR, 1400 lumens with 300watt lamp and five step output control, BrilliantColor from TI, 0.95 Dark Chip 3 DMD, 7-segment color wheel, 10-bit color per channel, TrueVivid, 3 HDMI plus external HDMI expansion, VGA (RGB/YPbPr/SCART), 2x RS-232, IR port, 2xRGBHV, 2 component analog, Gennum VXP, 10-bit 480i/576i/1080i motion adaptive deinterlacer using the included VX3000 video control unit below, software upgradeable from web site, connects to FP using HDMI.

On the right is the control unit VX3000 included with the projector (front, with door down, and back panel):

RPTV
BigVizion

1080p, TTM late 1Q06, customizable and modular 80 to 100-inch rear-projection display that can be either installed or built-into a wall, single-mirror system by TI, ISF 3C codes, light engine can be accessed from the front of the optical screen, 10000:1 CR, IR pass-through for system integration, component, DVI and HDMI, VGA, RGB, support 480i, 480p, 720p, 1080i and 1080p inputs, targeted for the professional installer market, customizable color scheme, bezel color to match a customers' décor.

80" HDBV3080 $17,000, TTM Mar 06
90" HDBV3090 $18,000, TTM Apr 06
100" HDBV3100 $20,000, TTM Apr 06, 30" deep

Panasonic
RPTV
50" PT-50DL54, 2500:1 CR, 8-segment color wheel

720p sets
0.8" chip, 2500:1 CR, ATSC/QAM/NTSC tuners, CableCARD, RGB PC inputs, HDMI, 8-segment color wheel
56" PT-56DLX75
61" PT-61DLX75

1080p sets (DLX76)
ATSC/QAM/NTSC tuners, CableCARD, SD Card and Photo Viewer, RGB PC input, HDMI, TV Guide On-Screen™ Electronic Program Guide, 30W audio system that includes a 15W sub- woofer, TTM June 06, $TBD, 13000:1 CR.

56" PT-56DLX76 (below)

61" PT-61DLX76 (below)

DL500D line, 720p
TC-52DL500D, TTM now, 2500:1 CR
TC-61DL500D, TTM 06, 2500:1 CR

Philips
First DLP RPTVs on Magnavox brand, 3Q05

2006 models Philips brand
PixelPlus video enhancement
50" $TBA
60" 60PL9200D $TBA, TTM 06, 720p

Projection Design
FP
F1+ 2500:1 CR, 1400x1050, 2500 ANSI lumens, 28db quiet operation.

Action model 3 1080
True 1080p single DC3 DMD 0.95", Crystalio II (according to them the world's most technologically advanced video processor) with 4th generation broadcast quality algorithms for superior SD and HD video image quality, dual 7 segment color wheels and light formatters, DuArch illumination architecture featuring dual lamps, TI's BrilliantColor SLR technology, 24/7 operation warranty, Gennum's VXP Visual Excellence Processing, adjustable output brightness from 550 to 2500 ANSI lumens.

Radio Shack
FP
Cinego D-1000 $1,300, projects at upward angle (for coffee table positioning), 854x480, HDTV input on component, built-in DVD player, stereo speakers and outboard bass module, 80" diagonal image from 8 feet away.

RCA (see **Thomson**)

Runco
Sep 05
FP
VX-2 Series 3-chip 720p HD-2 DMD
CineWide™ and CineWide™ with AutoScope™ technology optional on all models to obtain full capability of their DMD chips, displaying movies formatted in the 2.35:1 aspect ratio with increased resolution and brightness, and motorized anamorphic lens assembly via RS-232 commands.

State-of-the-art digital cinema optics, smallest 3-chip chassis 8-1/8" high, based on Runco's Cinema Standards Measurement System (CSMS™), the VX-2 series achieves a light output of 1,199 Home Theater ANSI Lumens, 52.1 foot-Lamberts (2,500 ANSI Lumens), and a CSMS contrast ratio of 271:1 (3,100:1 ANSI), dedicated outboard processing ViVix II™ DHD™ Digital Controller, eight inputs and field-upgradeable software installers can download.

VX-2i
VX-2c $40,000, 720p, 2500 ANSI, 2800:1 CR
VX-2dc

Technical Specifications

Scan Frequency:	Horizontal: 15 – 100 KHz, Vertical: 28 – 78 Hz
Recommended Screen Size:	Width: 72 – 120 inch; maximum width: 250 inch
Throw Distance:	Lens Option 1: Zoom 1.20–1.40 x width Lens Option 2: Zoom 1.40–1.77 x width Lens Option 3: Zoom 1.77–2.35 x width Lens Option 4: Zoom 2.35–3.60 x width Lens Option 5: Zoom 3.60–5.70 x width
Lens Option 6:	0.95 x width (rear-screen applications)
Light Output:	CSMS™ Specifications: 1,199 Home Theater ANSI Lumens; 52.1 Foot-Lamberts (fL); 2,500 ANSI Lumens
Contrast Ratio:	CSMS Contrast Ratio: 271:1; 3100:1 ANSI
Lamp:	275W UHP
Lamp Life:	2000 hours @ 6500º Kelvin
Controller Interface:	(1) DVI Connector
Dimensions:	19-3/16"W x 26-7/16"D x 8-1/8"H w/out feet; 9-3/4"H w/ feet
Weight:	81 lbs. (without lens)

Specifications for the DHD™ Digital Controller (Included with the VX-2c and VX-dc):

Aspect Ratios:	Anamorphic, Letterbox, VirtualWide, 4:3 (16:9 or 4:3 screens)
Input Standards:	NTSC/PAL
Outputs:	(1) DVI w/HDCP
Output Resolution:	720p
Inputs:	(1) Composite, (2) S-Video, (1) Component (480i or 576i), (2) RGBHV/Component HD, (2) DVI Digital w/HDCP
Control Options:	Discrete infrared remote, (2) RS-232, (1) 9-pin connector, (1) RJ-11, front panel controls
Trigger/Masking Outputs:	(3) 12V DC, 1/8A
Bandwidth:	150 Mega Samples/Second (MSPS)
Dimensions (w/o feet):	17-1/2"W x 11-3/16"D x 3-3/4"H
Weight:	13 lbs.
Included Accessories:	Rack mounting brackets

FP
Reflection Series (two new models)
720p, 96" recommended screen width

SuperOnyx™ technology uses the new Selectable Lamp Intensity Control™ (SLIC™) feature to create a powerful and versatile imaging system, with two light settings. The result is a projector that generates a vibrant and color-saturated picture within viewing environments with widely varied lighting conditions, ViViX™ digital video processing, HDMI, RS-232.

CL 610/610LT, 1150 ANSI lumens, 2200:1 CR
CL-810, 1250 ANSI lumens, 3100:1 CR
CL-810Ultra, optional upgraded lens package at the time of purchase, large range of throw distances and lens shift allowances, and advanced software, improve picture clarity and color saturation, more flexible horizontal and vertical shift, accepts Runco's exclusive CineWide™ technology for 2.35:1 AR images (for models 610 and 810 is also optional but only available at time of purchase).

SDC-1 Controller is an optional, stand-alone component controller specifically designed as a unique interface solution for both the CL-610 and CL-810 projectors. The SDC-1 Controller integrates controlling and switching of video sources via its R-Link™ cable, used between the SDC-1 and the projector, 2 HDMI, 2 RGB/component, serial port for RS-232 or RS-422 for automation control, AMX's `Device Discovery' feature, IR receiver, 4 trigger controls (3 for 12v, 1 dry contact closure), R-Link cable lengths of 25', 35', and 50'.

CL-420 affordable 720p, implements *Enhanced GEN 3* technologies that produce deeper blacks, greater contrast ratio and brightness, and richly saturated color, horizontal and vertical lens shift, variable throw distance, and keystone correction, discrete IR and RS-232 controls.

Signature Cinema SC-1, $250,000, TTM now, 2048x1080, 40 feet wide screen max, 9000ANSI, 1500-2800 CR.
Video Xtreme VX-80d 3-chip 1400x1050, 375" screen width, 8000 ANSI, 1500-1800:1 CR, DVI, RGB, 1000 hrs lamp (or 6 months).

Runco also introduced the CineWide with AutoScope technology for widescreen reproduction of movies originally filmed in the CinemaScope™ 2.35:1 format, maintaining constant vertical height on the screen while the image gets wider. The system uses a combination of software, electronics and remote controlled motorized anamorphic optics. A projector is then able to use the full pixel array on its DMD™ chips for a 2.35:1 image having enhanced resolution and increased brightness.

SAGEM
RPTV
720p, 3000:1 CR, 700cd/m2 brightness, 140 degrees viewing angle
AXIUM line
45" HD-D45S G4, silver finish, DVI/HDCP, DCDi
45" HD-D45H G4-T, piano black, 2 HDMI/HDCP
50" HD-D50H G4-T, piano black, 2 HDMI/HDCP, 6 analog inputs
56" HD-D56B piano black, 1 DVI/HDCP, 8 analog inputs, VGA, DCDi

Samsung
HL-R 68 Series

Floating screen design that separates screen and bezel from its base, Cinema Smooth™ Generation 6 1080P HD engine, 30 watts of audio.
56” HL-R5668W $4,200
61" HL-R6168W $4,700
67" HL-R6768W $6,000

HL-R 78 Series
Cinema Smooth™ 1080p Light Engine, latest generation of Samsung's DNIe video enhancer, NTSC/ATSC tuners.
50" HL-R5078W $3,700
56" HL-R5678W $4,200
61" HL-R6178W $4,700
71" HL-R7178W $6,500 (seen also at $5,000), TTM Nov 05, 10000:1 CR, dual HDMI, Gemstar, IEEE1394, CableCARD, DNIe, 130lbs

HL-R 88 Series
Cinema Smooth™ Optical Engine, 10000:1 CR, enhanced DNIe, ATSC/CableCARD tuners
56" HL-R5688W $5,200, pedestal DLP TV

SP 720p line current (China), HDTV-ready sets
L3HR sub-line, 1500:1 CR
46” SP46L3HR
50” SP50L3HR
56” SP56L3HR
61” SP61L3HR
L6HR sub-line, 2500:1 CR
42” SP42L6HR
46” SP46L6HR
50” SP50L6HR
61” SP61L6HR
67” SP67L6HR
L7HR sub-line, 2500:1 CR
50” SP50L7HR
56” SP56L7HR

2006 models
720p line
HL-S 86 Series
Pricing will drop $200-$300 from 2005 models, Game mode as above, USB 1.1 input for JPEG and digital music files, TTM Mar 06, 2500:1 CR.
50” HL-S5086W $2,300
56” HL-S5686W $2,700, HDMI
61” HL-S6186W $3,100

In 2006, all 1080p RPTVs will drop the premium of 1080p price (over 720p sets) from $1000 in 2005 to $500 in 2006.

1080p line

TTM 2Q06, HDMI inputs will be capable of accepting 1080p, LED light engine will replace the conventional Ultra High Pressure (UHP) lamp and extend bulb life from 6,000 hours to 20,000 hours maintaining consistent brightness levels throughout the life of the bulb, increase color gamut reproduction >100 percent of NTSC, turn-on time shortened from 30 seconds for UHP to seven for LED. The 56" 1080p LED set will be $1,000 higher than similar UHP models.

HL-S 87 Series
TTM Apr 06, 1080p, 10000:1 CR, hidden speakers, ATSC/NTSC/CableCARD tuners, 2 HDMI inputs, PC input, 1080p input capability, 15-wattx2 audio, DNIe, 10000:1 CR.
50" HL-S5087W $2,900
56" HL-S5687W $3,200 (below)

61" HL-S6187W $3,600
67" HL-S6787W mentioned but not confirmed

HL-S 78 Series
TTM 06, 1080p, 10000:1 CR
50" HL-S5078W
56" HL-S5678W
61" HL-S6178W
71" HL-S7178W

HL-S 66 Series
TTM Mar 06, 720p, 2500:1 CR, ATSC tuner, floating bezel, DNIe.
42" HL-S4266W $1,900
46" HL-S4666W $2,100

67" HL-S6768, TTM 06, 10000:1 CR (mentioned but not confirmed by press release)

LED based DLP RPTV

56" HL-S5679W $4,200, TTM Apr 06, 1920x1080p, LED light replaces current UHP bulb, 20,000 hrs life, 7 seconds turn-on time, ATSC/NTSC/CableCARD tuners, 10000:1 CR, IEEE1394, 2 HDMI 1080p inputs, quieter, black glossy finish (above).

FP
SP-H710AE $4,000, TTM now, HD2+ DMD chip, 1280x720, 250w lamp, 6-segment color wheel, 29db in theater mode, DVI-D/HDCP, 2xcomponent, PC input.

SP-H800BE $12,000, TTM now, HD2+ Dark-chip 3, 1280x720, 250w lamp, 8-segment color wheel, 10-bit processing, 28db in theater mode, DVI-D/HDCP, 2xcomponent, PC input.

SPH-700AE $12,000, 700 ANSI, 2800:1 CR, 720p.

Sharp
FP
DT-100, portable entry level, $1,300, TTM Oct 05, ED 480p 854x480p, 16x9, 1000 ANSI lumens, 2000:1 CR, 6-segment color 5x speed wheel, 30dB fan noise in economy mode, sealed optics protect the projector from dust, dirt and smoke when being moved around the home.

XV-2000, mid-level, $4,000, TTM now, HD 720p HD2+ chip, 1200 ANSI lumens, 2500:1 CR.

XV-Z3000, $3,500, TTM Apr 06, latest 720p chip, 6500:1 CR, 1200 ANSI lumens, 30dB fan, dual iris system, 3-2 pull-down, HDMI, 6-segment color wheel, demo with Studio Tech 130 by Stewart 123 screen diagonal, (right photo).

DT-500, $3,300, TTM July 06, 1280x768, 4000:1 CR, 1000 ANSI lumens, 8.6 lbs, powered optical iris, 6-segment 5x speed color wheel, I/P conversion, 3-2 pulldown, color management system, 3-step bright boost, HDMI (left photo).

Current Top-of-the-line FP
XV-Z12000 MARK II, $11,000, TTM Oct 05, 720p Dark Chip 3™, 1000 ANSI Lumens, 7000:1 CR, 7-Segment 5x-Speed color wheel, DVI/HDCP, "film tone", 1:1.35 manual zoom, lens shift function to simplify installation, 33 dB whisper-quiet operation.

Near future flagship model
XV-Z20000, $12,000, TTM 3Q06, 1920x1080p resolution, Sharp's CV-IC III Video Scaling Circuitry, DVI/HDCP and HDMI inputs, 1000 ANSI, 10000:1 CR. Excellent demo with Blu-ray at CES (below), will accept 1080p when released, (below).

SIM2 USA
FP
Grand Cinema Line
C3X LINK $24,000, TTM now, 3-chip 720p DLP, with 2nd generation remote DigiOptic Image Processor DOIP, 2 HDMI/HDCP, ALPHA Path light engine, 6500:1 CR, multiple lens options, RS232, USB, 20lbs.

C3X LITE $16,000, TTM now, 720p 3-chip, 2 HDMI, 5500:1 CR

C3X $N/A, TTM now, 5500:1 CR, 720p x3 chip, 2 HDMI.

HT3000 1080p 0.95" single chip, TTM spring 06, 10-bit DSP, 2 HDMI, 4000:1 CR, (right).

HT300 E-LINK, 720p, HDMI, HD2+ Dark chip 3 DMD.

HT300E, 720p, HDMI, 3500:1 CR, HD2+ Dark chip3 DMD.

Domino 55M (included in the CES 2005 report).

Thomson
CES
Thomson discontinued the ultra-thin RPTV line (co-developed with Infocus)
RPTV
Six new 720p models (one RCA brand), TTM summer 06, CableCARD/ATSC tuners.
RCA Scenium
2 HDMI/HDCP inputs, component, VGA, wired IR
50" M50WH185, $2,000, TTM June 06, 4 models as 185/6/7/8
61" M61WH185, $2,500, TTM June 06
RCA brand
50" M50WH72S $1,800, TTM Apr 06, HDMI, 2 component

Toshiba
May 05 (most MSRP prices below were reduced about $300 by Sep 05)
ATSC/CableCARD tuners, TV Guide On Screen(R) interactive program guide, IEEE1394 (DTVLink) for optional Symbio(TM) HD Recorder, TheaterNet(TM) 1394/IR control system for external device control, OmniViewer(TM) Memory Card Slot (accepts five types of memory cards) with JPEG viewer for viewing of digital photos, CableClear(R) DNR, SRS(R) WOW(TM), HD Window(TM) POP, Dual HDMI.

1080p sets technology
Digital Light Engine TALEN X, xHD4 chip, DEEP Picture and Xtreme BLAC technologies, PixelPure(TM) AT (Adaptive Technology) Digital Video Processing, Motion Adaptive De-Interlacing, Adaptive MPEG Processing, Adaptive Contrast Enhancement, Adaptive Color Enhancement, no 1080p input and no plans for it either, although Toshiba claimed 1080p could be input over the IEEE-1394 connection at CES.

720p sets technology
New TALEN engine with DEEP Picture(TM), PixelPure AT Digital Video Processing

TheaterWide line
Three 720p models
46" 46HM95 $2,500, TTM Jul 05
52" 52HM95 $2,800, TTM Jun 05
62" 62HM95 $3,300, TTM Jul 05
And three 1080p models
56" 56HM195 $3,500, TTM Aug 05
62" 62HM195 $3,800, TTM Aug 05
72" 72HM195 $5,000, TTM Sep 05

Cinema Series line
THINC(TM) (Toshiba Home Interactive Network Connection) home entertainment networking for PC connection, MP3, JPEG using TV remote.
Two 720p models, black cabinet with a high gloss black bezel
52" 52HMX95 $3,100, TTM Jul 05
62" 62HMX95 $3,600, TTM Jul 05
Three 1080p models, new cosmetic design featuring space-saving bottom speakers
56" 56MX195 $3,800, TTM Sep 05
62" 62MX195 $4,100, TTM Sep 05
72" 72MX195 $5,300, TTM Oct 05

Toshiba 1080p sets are only $500 more than 720p sets, while Samsung is charging $1000 more (but announced a reduction for 2006, see Samsung above).

CES

As mentioned on the LCD section, the company decided to use the CES show to make announcements that usually are done at their dealer show in spring. The company is investing in LCD and SED in 2006, while also carrying plasma as a mainstream product. Toshiba is abandoning the CRT RPTV line this year.

RPTVs

720p line

Talen 5 light engine, HD5 chip, Brillian Color 2 technology, Hi-Bright Radiance 150-watt lamp, PixelPure Pro 12-bit video processing (333 MHz) that produces real speed progressive scanning, increased dynamic range and sharpness, improved video noise reduction and dynamic gamma, new cosmetic look with SoundStrip speaker technology, small cabinet design (front dimensions smaller than same size plasma sets), silver finish for Theater wide, black for Cinema Series models.
50" 50HM66, TTM Apr 06, pictured above
56" 56HM66, TTM May 06

1080p line

Six new models in the line to be introduced at the 2006 spring show.

Vidikron

Dec 05
Horiz/vert lens shift, electronic keystone, enough light for 10feet-wide screens, "imagix" video processing, DVI/HDCP, component, VGA, RS-232, TTM now.
Model 10 $3,500, 1024x576, 780 ANSI, 2400:1 CR, DVI/HDCP
Model 12 $5,000, 1280x768, 820 ANSI, 2550:1 CR, DVI/HDCP
Model 30 $N/A, 1280x720, 1100 ANSI, 1350:1 CR, HDMI/HDCP
Model 90 $N/A, 3-chip 1280x720, 2250 ANSI, 3000:1 CR, DVI/HDCP
Model 100, $N/A, 3-chip 1280x720, 3500 ANSI, 2000:1 CR, DVI/HDCP
All other models are current; please consult the CES 2005 report for specs.

Vivitek

RPTV
42" RP42HD51A, 720p
51" RP51HD41A, 720p, 2000:1 CR
56" RP56HD21A, 720p, DCDi, 1500:1 CR
61" DVR-6130, 1080p, 1500:1 CR

Yamaha

FP

The company declared that they have no plans for 1080p front projectors in 2006.

DPX-830, $N/A, 720p Dark Chip 2, 4000:1 CR, 1000 ANSI lumens, Brillian Color Mode, 6-segment color wheel, 10-bit digital processing, user-selectable functions for

vertical and horizontal keystone and gamma corrections, HDMI, RS-232c, 26db fan noise.

DPX-1200, $12,500, 720p, uses the Realta HQV processor powered by Teranex with true 10-bit video processing, full four-field motion adaptive video de-interlacing for both standard definition and high definition signals, temporal-recursive noise reduction, automatic multi-cadence detection, and pixel-based detail enhancement. It also utilizes the same video processing power—1 trillion operations per second—as the famous $60k Teranex Xantus box, 5000:1 CR, 800 ANSI lumens.

DPX-1100 and DPX-1200 specs could be found also on CES 2005 report.

DPX-1300, $12,500, TTM Oct 05, 720p, 5th generation, follow-up model of the currently available, Dark Chip 3 DMD, 5000:1 CR, 800 ANSI lumens, 10-bit video signal processing, HQV Silicon Optix chip, HDMI, DVI, advanced scaling engine uses 1024 taps to scale resolutions up and down, and for correcting extreme keystone angles in both horizontal and vertical dimensions.

Zenith
(Please see **LG**)

Liquid Crystal on Silicon (LCoS)

(Includes Sony's SXRD and JVC's D-ILA)

Brillian

RPTV
The company demo their recently introduced RPTV set with a demo of a monitor that was set with external video processors.

6580IFB 1080p set (on left), accepts 1080p on DVI, Read the complete coverage of how this company implemented LCoS on the dedicated section within the 1080p subject. The HDTV includes an installer with the purchase (an ISF calibration for two inputs using the calibrator's ISF equipment).

eLCOS

Since Aug 2005's Display Search HDTV Conference the company is demonstrating their eHD70 microdisplays of 1920x1080 with 4000:1 CR using eLCOS's Dynamic Digital Drive technology for direct digital connection between the video input signal and the pixel circuitry of the microdisplay, avoiding analog artifacts such as flicker and cross-talk, To obtain a longevity the set uses a vertically aligned nematic liquid crystal mode with an inorganic alignment layer.

The demonstration was made with a projection engine named JDS Uniphase Ultrex ™, which included JDSU's proprietary BCE (Birefringent Compensating Element) for contrast enhancement.

The Silicon Optix Realta HQV video processor and Dai Nippon's FLL4.0 screen were implemented on this demonstration.

Faroudja

FP
DILA 1080p $40000, with DVP1080 HD video processor $6000
93 % fill factor, 250Watt mercury lamp, 3x0.8 chips, accepts 1080/60p, DVI-I/HDCP, D-sub 9-pin, 2100:1 CR, 1.3x Zoom lens, 40-200 inches screen size, no vertical lens shift adjustment (projector must be aligned with top of screen), no digital keystone adjustment.

Hitachi

RPTV
T925 Series (3 sets)
CineForm Light Engine, 1080p, reduced cabinet height, for a true flat-panel look when viewed straight on, fully integrated ATSC tuning, digital CableCARD slots, TV Guide On-Screen electronic program guides, IEEE-1394 and HDMI inputs, one of each is included the high-end Director's Series, which is restricted to select A/V specialty dealers, and one 60W-inch model will be offered as a regional exclusive piece to qualifying CE and TV appliance accounts, dual focus lens system.

60” 60T925 $5,300, TTM Nov 05
70”

X927 Director’s Series (hi-end line)
Same as 925 line plus learning AV NET IV system with simple remote, Digital Color Management III system that can store two settings – one for photo memory card input and one for other video sources – and Custom Color Temperature controls with four memories.
60” 60X927 $6,500, TTM Nov 05
70” 70X927 $8,500, TTM Dec 05

JVC (D-ILA)
RPTV
JVC demo again their 1080p and 720p sets. As on the CES 2005, the 70” was demo on a private room with controlled lighting. JVC’s 2006 RPTV D-ILA models will not accept 1080p externally. The company also demo a slim line with a 56” prototype set with 10” depth, as a technology statement for a new optical projection system (below).

JVC is exploring the use of LEDs as the light source for both HD-ILA RPTVs (replacing the current high-pressure mercury lamp) and flat panel LCD sets (replacing the current CCFL light source). According to JVC, LED backlighting offers faster response time for detailed fast motion images, and deliver more vivid color images, and. reduced hold time for less blurring and ghosting. JVC also demo a Quad HD-ILA for presentation and commercial applications.

RPTV Consumer Series

On Sep 05, JVC introduced three new sets (TTM Oct 05) with built-in ATSC tuners and digital CableCARD slots and feature dual HDMI with HDCP inputs, two IEEE 1394 FireWire ports, PC input, optical digital audio output and a media card reader.

Each model uses three of the company's new 0.7-inch 1,920 by 1,080 D-ILA chips, fifth generation of JVC's Digital Image Scaling Technology (D.I.S.T.) and Genessa, a 32-bit CPU dedicated to controlling picture refinement, Digital Noise Suppressor that detects and eliminates "block noise," a Mosquito Noise Suppressor that eliminates noise without degrading the image, and a 3D Y/C comb filter with DTV Cross Color Eliminator that uses an advanced 10-bit 3D Y/C separation process to eliminate cross color and dot interference, Five-Point Color Management System, Motion Adaptive Dynamic Gamma Control, Digital Super Detail edge enhancement, Digital Noise Clear circuitry, and five video status settings (D6500K, standard, game, theater, dynamic).

56” HD-56FH96
61” HD-61FH96 $5,500
70” HD-70FH96 $7,000

The 70” 1080p above was demo with the Iodata unit on the right for reproducing recorded 1080i content.

RPTV Professional Series

Sep 05

3-Chip Direct Drive Image Light Amplifier (D-ILA™) technology, 1080p, slim design, RS-232C serial control ports, HDMI inputs, ATSC/CableCARD tuners, color corrected to D65 by using optical filters for a more accurate and dynamic image, rather than electronic compensation, which can limit the dynamic range, NO 1080p inputs.

61” HD-P61R1U, $7,000 ($5,000 Internet)
70” HD-P70R1U, $9,000 ($6,500 Internet)

FP
DLA-HX2E projector, £4767, TTM May 05, 3-chip D-ILA, dedicated widescreen, HDCP decoder, 1500:1 CR, resolution of 1400x788 (WXGA+), 500 ANSI Lumens, throw size of 37-220in. (diagonal), and throw distance of 1.56-12.56m. Supports PAL, SECAM, NTSC and NTSC 4.43 video formats, HDTV (1080i, 720p, 576i/576p, 480i/480p), component, DVI/HDCP, DIST (Digital Image Scaling Technology), (298x360x134mm, 5.9kg).

2006 lines
Optical Iris, 5th generation DIST, JVC's Genessa 32-bit CPU video processing, dynamic auto iris, ATSC/QAM/NTSC tuners, 2 HDMI, 2 component, PC input.
RPTV 1080p series (right)
TTM July 06, still NO 1080p acceptance,
3 x 0.7 inch 1920x1080 chips
56" HD-56FN97 $3,500
61" HD-61FN97 $3,800
70" HD-70FN97 $5,500

RPTV 720p series
TTM Mar 06, 3 x 0.7" 1280x720p chips
52" HD-52G787 $2,800
56" HD-56G787 $3,200
61" HD-61G787 $3,500

I reported on my last CES 2005 report that in my opinion the 70" 1080p DILA was better compared to the SONY SXRD and Samsung DLP 1080p sets, when they were all just introduced at that time. I would like to indicate that this time I noticed an effect that the more I looked at it the more it bothered me: apparently the lenticular screen gives large images of firm color (like a blue sky) the impression of an artificial pixel movement that interacts with the movement of the image itself. I did the same type of viewing to the set installed on a dedicated darker room and the effect was less obvious, but still there. I would suggest to the prospective buyer to perform the viewing test on both types of room lighting to make sure is not an issue of concern, as it was to me, additionally, having JVC no plans for 1080p inputs on the year of 1080p Blu-ray makes this choice not as obvious as it was at CES 2005.

FP
Introduced Feb 06
New Flagship
DLA-HD10K $25,000, TTM now, 3-chip D-ILA 'non-moving' mirror reflective technology, 1920x1080p, accepts 1080p 48/50/60 fps over DVI-D, high-resolution lenses with motorized zoom and focus with a 0-60% vertical offset, two models: a long throw with a lens throw distance of 2-3.8:1 (placement of the projector at the back of the theater), for a 10-foot screen, the projector could be placed anywhere from 20 to 38 feet from the screen, and a short throw model with lens throw distance of 1.5 - 2.0:1 to

facilitate projector to be used for CRT replacement or rear screen applications, 2500:1 CR, 27db quiet fan noise, user-replaceable lamp with 2000 hrs life at $500, Faroudja, Silicon Optix, and Anchor Bay Technologies are planned to supply three different external digital signal processor packages with this model.

http://pro.jvc.com/prof/Attributes/features.jsp?tree=&model_id=MDL101568&itempath=&feature_id=01

LG

LG announced these models at CES 2005 (check report for specs), and were expected introduction around mid-2005 (now shifted to 1Q06).

71" 71SA1D, $8,500, TTM Feb 06. The set has 1920x1080p resolution, digital-cable-ready w/CableCARD, ATSC tuner with LG's 5th generation VSB chipset, proprietary XD Engine able to upconvert SD to almost HD quality, HDMI/HDCP, IEEE-1394 DTV Link, 9-in-2 memory card slots, Gemstar TV Guide Onscreen IPG, 3500:1 CR, <22" deep. The set was reported to accept 1080p over HDMI, a feature that could not be verified.

62" 62SA1D, $5,000, TTM Feb 06, 1920x1080p, HDMI/HDCP, IEEE-1394, CableCARD tuner, ATSC tuner, TV Guide On Screen EPG.

However, in March 2006 LG announced the withdrawal of the products due to "certain part procurement issues" VP Bob Perry said.

SONY (SXRD)

Aug 05

RPTV

Grand Wega Silicon X-tal (Crystal) Reflective Display (SXRD) technology 1920x1080p, three new 0.61-inch SXRD glass panels mated with a back plane before being cut into individual panels, to reduce cell gap size, dust contamination, and meet higher yield rates, 5000:1 CR, "Advanced Iris" and Sony's Cinema Black Pro mode for 10000:1 CR, ATSC/CableCARD tuners, Master Digital Amplifier and SRS TruSurround audio effect, dual back HDMI (one w/audio, one without), 2 component, three i.Link (IEEE 1394), PC input, optical audio output, Memory Stick flash-media viewer, no EPG, TTM Oct 05, $500 optional matching stand, 120w UHP lamp, 5ms total response time, viewing angle 60 degrees.
60" KDS-R60XBR1 $4,500 (Feb 06 reduced price)
50" KDS-R50XBR1 $3,500 (Feb 06 reduced price)

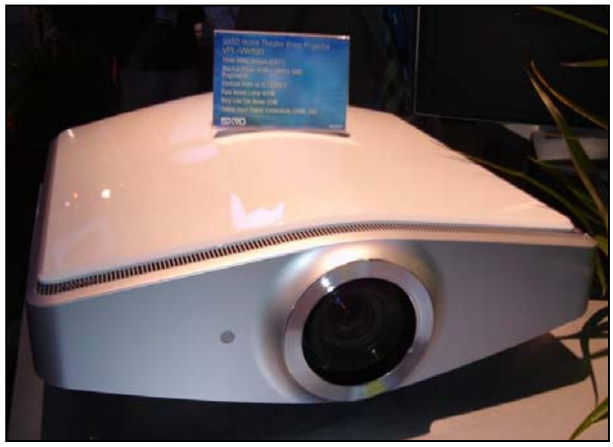
CES

RPTV

The company introduced a 55" slim cabinet (30 % slimmer that current 50" model) SXRD HDTV with 1080p resolution, which claimed to accept 1080p and has 5000:1 CR.
Sony also showed the current SXRD RPTV model with a Blu-ray player demonstration, the current models will be followed with a second generation of RPTVs that was said to accept 1080p to match their 1080p/60fps Blu-ray offering; it was not indicated if new sets would accept 24fps from a Blu-ray player and jump internally to 60fps, Sony did not want to confirm if the demo slim line will be 2nd generation replacement for the current RPTVs. The sets will be made available later

in the year, possibly summer 2006 or later, no pricing was provided. No confirmation was issued to a possible release of an XBR version of the QUALIA 70" model.

FP
VPL-VW100 (Ruby)
Shown again but not demo at CES was this Sony's projector using SXRD technology, TTM Nov 05, $10,000, 1080p 3x0.61" panels, little brother of Qualia 004, 15,000:1 CR with Advanced Iris Function on, 400-watt Pure Xenon Lamp ($1,000), accepts 1080p/60fps over DVI and HDMI, low fan noise 22dB, 1.8X Zoom, Lens Shift, DRC-MFv2, vertical keystone, auto input search, projection picture size 40 to 300 inches diagonally, although Sony recommended not larger than 120" (as below), projector shown at right.



At the SONY booth the rep seemed to know this projector very well, he indicated that the projector performs better scaling and video processing than most external scalers, he was not sure if the projector would disable the internal down to 1080i to jump back to 1080p when feeding 1080p to its input, which surprised me. It uses pixel-by-pixel motion adaptation deinterlacing. He recommended a Stewart white/gray screen not larger than 120" and 1.3 of gain; the Firehawk and DaLite screens were said to work well, with a minimum distance of 9" for maximum brightness.

4K Digital Cinema SXRD projector, the King of CES 2006 front projectors:
Specs included in the 2005 report.
SRX-R110, introduced at Digital Cinema Laboratory in Hollywood, CA; resolution of 4096x2160, compatible with 2K projectors of 1920x1080, judged as with a picture quality of at least 35 mm, 10000 ANSI lumens, 3000:1 CR (expected at 2000:1 in the production units), expected in movie theaters by 2005, dual-screen mode for the projection of dual 1920x1080 images, and

quad-mode for four 1920x1080 images, $80,000, $15,000 extra for lens, TTM Jan 05, suitable for up to 40 feet wide screens.

SRX-R105, $60,000, 5000 lumens, smaller version, suitable for up to 25 feet screens.

LCD Projection (FP and RPTV)

Epson
Introduced at CEDIA Sep 05
RPTV
Two CrystalPRO™ HD Displays 1080p, TTM Jan 06
Targeted at the custom installation market, OptiFocus™ optical engine, Auto Iris technology for 5000:1 CR, glossy black exterior designs with space-saving dimensions, 10-bit, 3D Digiscan™ digital video processing, multiple screen modes, built-in 30-watt (15x2) amplifier for external speakers, pre-set and customizable color modes, 3D graphic user interface, two HDMI/HDCP ports, PC input, and RS-232 controls.
55”
65”

FP
MovieMate™ 25 Projector-DVD/Music Player Combo, TTM Oct 05, $1,200
480p 3LCD 854x480p 16:9, built-in, multi-format DVD player and JVC self-amplified speakers (10-watt x 2), 1,200 ANSI lumens brightness, portable 80-inch pull-up, floor-standing, 16:9-wide screen included, display CD-R/RW videos, JPEG digital photos, WMA video files, external 40-watt subwoofer included, 1.5 lens firing forward rather than upward, screen raises from floor case using a back bar, no HDTV connections only composite and s-video.

Pocket Projector
800x600, 3 LCD, LED source, 1.1 lbs, technology exhibition

New generation of three-chip, Dynamic Eye Iris
Three projectors TTM Oct 05
PowerLite Home 20: entry-level 480p, $1,000, 1000:1 CR, 1,200 ANSI lumens, optical/offset lens shift for easy setup without distortion, automatic aspect ratio adjusting, six preset color modes, short-throw flexibility, 80-inch image could be projected from just 6.6 feet away, includes an 80-inch screen, pull-up, floor standing.

PowerLite Cinema 550: 720p, $2,500, seven color modes, 3000:1 CR, 1,400 ANSI lumens, HDMI, new video noise reducing technology, cinema filter to provide accurate colors and rich blacks, customized gamma and six-axis color adjustment, vertical/horizontal sharpness adjustments.

PowerLite Cinema 800: Epson's flagship, 720p, $4,500, 5000:1 CR, 1,600 ANSI lumens, 10-bit color to project more than one billion colors, offers ISF-certified (Imaging Science Foundation) calibration and advanced IR/RS-232 controls.

Hitachi

FP

PJTX100 $3,000, TTM now, 3 Panel 720p, Super Focus Quattro ELD can create an image from 30 to 300 inches, lens shift capability as well as 1.6x zoom, allows off axis installations without having to use digital correction, the lens system shifts the image both vertically and horizontally, maintaining detail and sharpness.

Two new models (Sep 05)

UltraVision(R)

HD-PJ52 $4,000, TTM Sep 05, 720p, Hi-2 Dual Iris System, 5000:1 CR, 10-step, remote motorized lens iris, Lamp Iris can also be independently opened and closed by degrees, nine-step gamma curve adjustment, Super-Focus Quattro ELD Lens technology to be placed off-axis from the center of the screen without requiring digital correction, 1.6x optical zoom, image up to 300 inches, 3:2 film processing, 1,200 Lumen Light Output, HDMI-HDTV Input, user-replaceable 150-watt lamp, "whisper quiet" 24dB fan, measures 5 11/16" x 13 3/8" x 11 3/16", weighs 10.8 pounds.

ED-PJ32 $1,300, TTM Sep05, 854x480p Enhanced Definition, Hitachi's exclusive glass lens with digital zoom, 3:2 Film Processing 1,300 Lumens, three pre-set picture modes (Normal, Cinema and Dynamic settings), 1.2x Digital Zoom Control, "whisper quiet" 32db fan with front exhaust, consumer replaceable 165-watt lamp, D-Sub (female) component, measures 3" x 11" x 8", 4.8 lbs.

RPTV

All new 720p for national accounts and regional independent dealers

VF820 Series

New Virtual HD 1080pII with 12-bit/68 billion color video processor, ATSC and NTSC tuners, CableCARD slots, dual HDMI, and dual wideband component video inputs, Ultra-Slim form factor with a plasma appearance and all black metallic finish. Three-Panel 720p LCD Light Engine with Exclusive Dual Focus Lens System.
50" 50VF820 $3,100, TTM Aug 05
55" 55VF820 $3,400, TTM Sep 05
60" 60VF820 $4,000, TTM Aug 05

CineForm VG825 Series

Same features above plus illuminated roll and click remote, CineForm cosmetics, Learning AV Net IV IR integration system, and USB input, TTM Sep 05.
50" 50VG825 $3,200
55" 55VG825 $3,500
60" 60VG825 $4,100
Also offered:

50” 50V720 2,800, TTM Sep 05, ATSC/NTSC tuning, CableCARD slot, VirtualHD 1080p II processing, high contrast lens, and HDMI input.

2006 line additions
UltraVision LCD RPTVs
720p 3-LCD panels, 11-Element Lens System, ATSC/NTSC tuners, Cable CARD, HDMI, 2 component, multiple color temperatures, Virtual HD 1080p video processor
50” 50VS69 $2,300, TTM Jul 06
55” 55VS69 $2,600, TTM Apr 06
62” 62VS69 $3,000, TTM Apr 06

Panasonic
RPTV
LCX66 Series
ATSC/NTSC/QAM tuners, 720p, optical output, SD memory card, RGB PC input, HDMI, 2 component, VGA/SVGA/XGA, $ TBD, TTM May 06.

52” PT-52LCX66
56” PT-56LCX66 (right)
61” PT-61LCX66

Sanyo
RPTV
720p, 150-watt / 10000 hrs lamp, 10-bit video processing, TTM 3Q06, $TBA, HDMI, 1000:1 CR, ATSC/QAM tuners.
55” PLV-55WHD1
65” PLV-65WHD1

FP
PLV-Z4, $2,200, TTM Nov 05, 12 bit, 7000:1 CR, 145watt lamp, HDMI, 100” screen image from 3 meters away.

Viewsonic
FP
CV100, $1,000, 480p, 1000 ANSI lumens, 2000:1 CR, 16x9, DVI/HDCP, motion adaptive deinterlacing with 3-2 pulldown, reduced noise output, 4000 hrs lamp life.

Plasma Panels

Audiovox
TTM Apr 06, ATSC tuner, DCDi, 2-2 & 3-2 pulldown, DVI/HDCP
37" FPE3706 $2,500
50" FPE5006P $3,500

Cinemateq
50" CT-50 HD 1366x768, plus II SDI control box with 8 inputs, 3.5" deep, 3000:1 CR, optional input box with HDMI input.

Daewoo
DVI/HDCP, IEEE1394
42" DTV-4220EA EDTV 480p, $1,500, TTM Mar 06
42" DTV-4230HA 1280x720, $1,800, TTM Mar 06

Dell
50" W5001C $3800, dual HDMI, ATSC tuner, 1366x768

Fujitsu Hitachi
Sep 05
UltraVision® HDS52 Plasma HDTV Series
Ultra-Slim form factor with narrow side speakers and all black finish, Power Swivel by remote is standard for the 42-inch model and optional for the 55-inch model, new VirtualHD(TM) 1080p II with 12-bit/68-billion color capability and dynamic histogram processing to improve contrast, color, sharpness and gamma by processing each video frame as a digital still image, Alternate Lighting of Surfaces (ALiS) panel technology minimizes the barriers between pixels to deliver more than one million pixels in the 42-inch screen size, ALiS is designed to match line for line with the viewable center 1024 lines of the 1080i HDTV system, 60,000-hour useful life rating, Quick Start Seamless HDTV and NTSC tuners, 2 HDMI, 2 component, anti-reflective screen coatings, multiple color temperatures, including a black-and-white film temperature, and 4-step black enhancement.

42" 42HDS52 $4,300, TTM June 05
55" 55HDS52 $5,800, TTM Oct 05

UltraVision® CineForm(TM) HDT52 Plasma HDTV Series
DVI and IEEE1394 interfaces with full AV control to make recording to hard disk drives convenient and easy, TV Guide On Screen electronic program guide system, IEEE-1394 interfaces, high-end industrial design with high-gloss black highlights and learning AV NET IV IR system integration with easy remote.

42" 42HDT52 $4,400, TTM Aug 05
55" 55HDT52 $5,900, TTM Oct 05

UltraVision® CineForm(TM) Director's Series(TM) models
ATSC/NTSC tuners, VirtualHD(TM) 1080p II Digital Video Processor, 3:2 pull down to insure a smooth and seamless display, multiple picture aspect modes, split screen and picture-in-picture, three color temperatures, SRS(TM) and BBE(TM) sound, digital 4MB 3D Y/C comb filter and an anti-reflective high-contrast glass shield.

42" 42HDX62 $5,500, TTM August 05
55" 55HDX62 $6,500, TTM October 05

42" 42HDF52 $3,800, TTM June 05, HDTV, 1024x1024
42" 42EDF42 $2,700, TTM Aug 05, EDTV

Oct 05
The company has announced the world's smallest 1080p plasma panel:
42", pixel size is 0.16mm(x3) x 0.48mm, TTM N/A.

2006 line
Dual HDMI, ATSC/NTSC/QAM tuners
42" P42XTA51US $6,000, TTM early 06, 1024x768
50" P50XTA50US $8,000, TTM early 06, 1366x768

HISENSE
Sep 05
One of China's top five electronics manufacturer
ATSC tuners, DCDi, 3:2 Pull-down
42"
50"
63"

Hitachi
Technology demonstration at CES of a 55" panel:
55" 1080p

HDS52 models
AliS technology, VirtualHD 1080p II Video Processor
42"
55"

HP
2006 line
10,000:1 CR, ATSC/NTSC tuners
42" PL4260N
50" PL5060N

LG
Dec 05 in Korea
42" 160GB DVR for 13 Hrs of HD, or 63 of SD, 9 in 1 memory card reader for CF, MD, SD, SMC, MMC, MS, MS Pro, Magic Store or Xd-Picture.

CES

LG announced 8 integrated plasma models for 2006 using their new XD Engine video-enhancement circuitry with 14-bit color processing for 4.4 trillion colors. Four models with 160 GB HD DVR capabilities and dual ATSC tuners, others with CableCARD tuners, nine-in-two flash-memory card readers, IEEE-1394, TV Guide On Screen EPG, all models have 1366x768 resolution, HDMI, Image Sticking Minimization mode.

50" 50PC1DR $5,000, TTM 1Q06, 768p, HD DVR, 2 HDMI, TV Guide On Screen EPG, CableCARD and ATSC tuners, black/silver gloss (50PC1DRA model in black gloss finish, $5,200).

Three 42" integrated models, TTM 1Q06
42" 42PC1DA $3,500, ATSC/Digital Cable ready, dual HDMI/HDCP
42" 42PC3D $3,000, ATSC only tuner, PSIP EPG
42" 42PC3DV $2,000, EDTV, ATSC tuner, PSIP EPG, HDMI and PC inputs

50" 50PC3D $4,000, TTM Mar 06, NON-HD DVR model, TTM March, ATSC tuner, but NO CableCARD tuner, HDMI, PC input, 768p

PB2DR series

$TBD, TTM 3Q06, 768p, 160 GB DVR, 14 color processor, 10000:1 CR, 2 ATSC tuners, dual HDMI, IEEE1394, component, RGB
50" 50PB2DR
60" 60PB2DR

47" 47LB1DRA $TBD, TTM Aug 06, 1080p, HDMI, component, RGB

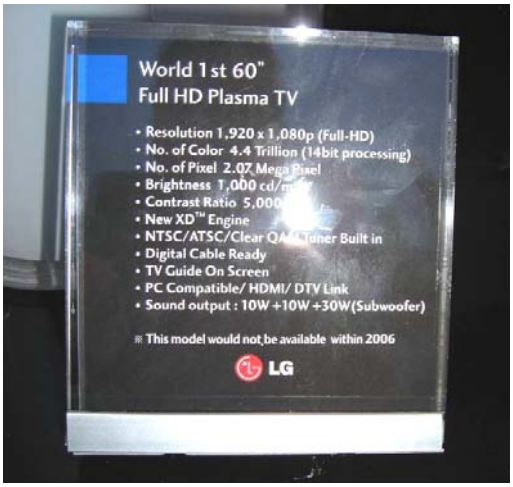
50" 50PB2DW wireless plasma panel

71" MY-71PY10 1920x1080p, $70,000, 2005 model continues (right, check 2005 report for complete specs).

Shown also at CES the following technology statement of a large plasma
102" 1920x1080p, 5000:1 CR, 1000 cd/m2 brightness, NTSC/PAL/SECAM tuners, TTM N/A, $ N/A, (left).

LG announced in Feb 06 that their DVR suited TS will have 250GB HHD drives (rather than the current 160GB), the new models will be released by the end of the year.

Also shown was the world's first 60" 1080p plasma (according to LG)
60" $N/A, TTM after 2006, 1920x1080, 5000:1 CR, 1000 cd/m2 brightness, NTSC/ATSC/clear QAM tuners, PC compatible, HDMI, DTV Link (below).



Maxent
Oct 05
50" MX-50X3, $3,000, TTM Oct 05, WXGA resolution 1366x768, 3000:1 CR, 900 cd/m2 brightness, MotionDSC(r) video processing to support 3:2 and 2:2 pull-down, digital noise reduction, IIS(tm) (Intelligent Image Scaling) Engine, RS-232, HDMI/HDCP, RGB input, 2 component, external subwoofer output, integrated speakers.

Mitsubishi
Aug 05
65" commercial HD 1080p panel, expected to be introduced in Japan in November 05, a new integrated 65" panel (with tuners) replaced the model for about half the price.

NEC
Sep 05
The company announced the redesign of 3 panels to incorporate among others HSF C3 calibration settings and two HDMI inputs, black bezel with silver outline and slim profile, 2 HDMI/HDCP, 60,000 hour phosphor half-life.
Showcase Series XGA
42" 42XR4 $6,000, TTM Nov 05
50" 50XR5 $8,000, TTM Dec 05
63" 61XR4 $14,000, TTM Nov 05 ($11,500 Feb 06), right

NIKADA
Jul 05
DVI/HDCP
42" PD1422 $3,900
50" PD1501 $6,550

Norcent
CES
VION line
42” PT-4291 $2,100, 1024x768, black, ATSC/NTSC tuners, 2x component, 1100 cd/m2 brightness, 1000:1 CR.
42” PT-4210 $1,900, TTM Mar 06, 720p, DVI
42” PT-4242HD $2,200, TTM Mar 06, 720p, DVI

Panasonic
May 05
PX500 line
1366x768, ATSC/CableCARD tuners, TV Guide OnScreen EPGs, 3,000:1 contrast ratios, sub-pixel controllers, six-speaker audio systems and 8.58 billion color capabilities, HDMI-HDCP input, and a Photo Viewer with SD Memory Card and PCMCIA Card slots.
42” TH-42PX500U $4,000, TTM July 05
50” TH-50PX500U $5,500, TTM Jun 05

PX50 line
Most of above features, except EPG and different speaker system
37” TH-37PX50U $3,000 (price drop of 25% from previous model)
42” TH-42PX50U $3,400 (price drop of 36% from previous model)
50” TH-50PX50U $5,000 (price drop of 29% from previous model)

42” TH-42PV50 EDTV, TTM April 05, held #1 market position within two weeks of release.

ONYX Series
Tuning and CableCARD slots through an outboard media box.
42” TH-42XVS30U
50” TH-50XVS30U
65” TH-65XVS30U

Sep 05
Panasonic reduced the price of select models of the above lines, and the ONYX series.
PX50 line price reductions
37” PD-37PX50 was reduced $500 to a $2,500 MSRP
42” PD-42PD50 entry model was reduced $500; it is now $2,000 MSRP
42” PD-42PX50 was reduced $500 to $3,000 MSRP
50” PD-50PX50 was reduced $1,000 to a $4,000 MSRP

PX500 line price reductions
42” TH-42PX500U is now $3,500 MSRP
50” TH-50PX500U is now $4,500 MSRP

ONYX Series price reductions
42” TH-42XVS30U is now $5,500 MSRP
50” TH-50XVS30U was reduced $1,000 to $8,000 MSRP
65” TH-65XVS30U was reduced $1,000, to $19,000 MSRP

Panasonic introduced the 8-Series in Sep 05

The new models offer improved image quality, high contrast ratio of 3000:1, and a new design with an ultra-slim bezel and hidden touch controls, 60,000-hour life.
37" TH-37PHD8UK
42" TH-42PHD8UK
50" TH-50PHD8UK
65" TH-65PHD8UK

And two SD displays, 4000:1 CR.
37" TH-37PWD8UK
42" TH-42PWD8UK

Nov 05
A flagship 65" model TH-65PX500
1080x1920p panel was "announced in the plans" to ship for Nov 05 for $9,000.

CES
The company introduced a new line of plasma models:
600 Series
ATSC/NTSC/CableCARD tuners, HDMI/HDCP, PC inputs, SD card slot, TV Guide On Screen EPG, TTM spring 06.
42" TH-42PX600U $3,200, 1024x768
50" TH-50PX600U $4,200, 1366x768
65" TH-65PX600U $TBD, 1920x1080p, TTM Aug/Sep 06, (booth reps commented that Japan is selling the unit for $10,000, and is expected to be at $8000 when released in the US), 1080p acceptance expected for later in the year (upon HDMI 1.3 later release they said, although 1080p is actually not exclusive on the 1.3 version), PC input, NTSC/ATSC/QAM CableCARD tuners, HDMI version 1.2 inputs with HDAVI control, TV-Guide EPG, left, good blacks, skin color very nice, all natural colors, pixel structure viewable from 3 feet away, best plasma on that size.

Future 1080p models would start from the 42" size.

58" model mentioned but not confirmed

60 Series
ATSC/NTSC tuners, HDMI/HDCP, SD card slot, NO CableCARD, TTM spring 06
37" TH-37PX60U $2,200, 1024x720
42" TH-42PX60U $2,600, 1024x768
42" TH-42PD60U $2,000, 852x480p EDTV
50" TH-50PX60U $3,700, 1366x768
58" TH-58PX60U $5,500, 1366x768 mentioned but not confirmed

103" 1080p plasma panel prototype was shown as a technology statement, picture on the right:

Philips
Jun 05
ATSC/CableCARD tuners
42” 42PF9630A $3,000, 2 models
42” 42PF7320A $2,700, 2 HDMI
50” 50PF9630A $4,800, AmbiLight 1
50” 50PF9830A $5,300, step-up model, AmbiLight 2, TTM Sep 05
50” 50PF7320A $4,500, 2 HDMI

According to Philips, AmbiLight 2 further refines the backlighting system by adding separate systems for each half of the screen. This gives a stereo effect to the synchronized backlighting technology.

CES
42” 42PF9631D $2,500 TTM June 06

50” $3,500 TTM June 06, AmbiLight 2
50” 50PF9731 $4,000, TTM July 06, AmbiLight full-surround for rear illumination on all four sides of the panel (below)

63” model to be introduced, specs N/A

Pioneer
Aug 05
Four new plasma panels with sixth-generation glass and enhanced video processing circuitry, advanced continuous emission IV” technology that dynamically adjusts the grayscale to provide five times more detail in dark areas than previous models, slimmer bezels, ATSC/NTSC/CableCARD tuners, 2 HDMI, 2 iLink, 3 component, 1 D-sub, table top stand, 5 aspect ratio controls, 5 video selection memories (Elites adding ISF day/night), detachable full-length speakers and a subwoofer output, and

SRS TruSurround circuitry with three surround sound modes, Advanced PureCinema II video processing with 3:3 pulldown, First Surface Pure Color Filter to reduce ambient light reflections, Elite models boast a Home Gallery photo viewer and an outboard media receiver.

43" PDP-4360HD $4,500, 1024x768
50" PDP-5060HD $6,000
Elite models
PRO-930HD $5,000, 1024x768
PRO-1130HD $6,500, 1280x768

CES
Pioneer demo their new 1080p 50" plasma model Elite PRO-FHD1, MSRP $10,000, TTM June 06, up-scales video to 1080p, HDMI, DVI, component, optional tabletop stand and wall-mount bracket. The demo was done with their new Blu-ray player, accepts 1080p.

The panel uses Pioneer's Pure Crystal Emissive Layer and First Surface PureColor Filter technology for the efficient use of smaller pixels in plasma cells, and Deep Encased Cell Structure to improve brightness and image accuracy, according to Pioneer. I addition the panel uses PureDrive III signal processing system to reduce the noise and obtain high contrast and natural color images.

The panel was introduced as a "monitor", which would mean that an ATSC tuner has not been integrated into the set. It could not be confirmed if the naming convention of "monitor" was loosely used, or was actually meaning that. The current 61" model was not confirmed for replacement in 2006 by a 1080p version, or any version.

Samsung
Sep 05
The company showed the new models available at specialty A/V retailers.
72 Series
HDMI, ATSC/CableCARD tuners, DNIe, TTM now
42" HP-R4272 $3,700
50" HP-R5072 $4,700
63" HP-R6372 $12,000, 10000:1 CR, 1300 cd/m2 brightness, 13-bit video processing, 175 degrees viewing angle.

In October 05, Samsung announced that the 80" HP-R8082 panel is in production and will be released for sale in Feb 06, for $150,000 (not $39,000 as originally disclosed at CES 2005).

I discussed the price discrepancy issue with Samsung representatives at CES, I was told that four units were already delivered, but no official clarification was given for the price discrepancy.

For that reason, I requested Samsung to issue an official statement. Mr. Bill Dickey, Sr. Marketing Manager, Plasma Displays, Samsung Electronics America submitted the following statement for this report:

"When we first introduced the product in 2005 the pricing provided to the media was based on production/sales levels of 1,000 units per month, as well as utilization of a new mass-production line at Samsung Display and Digital Interface (SDI), our sister company.

After introducing the concept TV, the required order volume did not materialize and SDI chose not to invest in a new line to build the 80" PDP. Because of these dynamic market conditions, the 80" displays produced today are essentially hand-made on a pilot production line with a current capacity of 3-4 modules per month.

Because of this limited production capacity, we are unable to achieve any economies of scale in procuring the components necessary for manufacturing this large panel. Compounding this is the additional manpower required to achieve the extremely high quality levels required of Samsung flagship products, due mainly to the lack of automated production processes.

Finally, because we are shipping these massive TVs singly, rather than in container quantities as planned, the transportation costs have skyrocketed.

For these reasons, Samsung has had to increase the market price of the HP-R8082 to the current $150,000 level. If demand increases enough to justify the investment in plant and personnel, SDI will invest in a new production line and the price would be expected to drop to the previously proposed levels."

Samsung has demonstrated again their 102" prototype plasma panel at CES. No pricing and no expected availability were provided.

<u>CES 2006 lines</u>
<u>73 Series</u>
2 HDMI, 2 component, anti-reflective film, 175 degrees angle, ATSC/DCR tuners.
42" HP-R4273 $3,300, TTM Jul 06
50" HP-R5073 $4,300, TTM Jul 06
63" HP-S6373F $N/A (but $11K was estimated), TTM N/A, (right), 1920x1080p panel, 3000:1 CR, 1000 cd/m2 brightness, ATSC & NTSC tuners, digital cable ready, 2 component inputs, HDMI, PC input.

<u>53 Series</u>
ATSC/NTSC tuners
42" HP-R4253, $3,000, TTM Apr 06
50" HP-R5053, $4,000, TTM Apr 06

Thomson
<u>2006 line</u> TTM Apr 06
42" P42WHD500 $1,800, 3 models in this size, DVI and HDMI, VGA for PC
50" $2,100

Toshiba
CES
Next generation PixelPure(TM) AT Digital Video Processing
AT includes:
- Motion Adaptive De-Interlacing
- Adaptive MPEG Processing
- Adaptive Contrast Enhancement
- Adaptive Color Enhancement
HDMI, CableCARD, TV Guide On Screen

Cinema Series
720p True HD panel, PC input, IEEE1394 (DTVLink) for connection to an optional Symbio(TM) HD Recorder, THINC(TM) (Toshiba Home Interactive Network Connection) to connect a computer and playback MP3 files and JPEG files, using only the TV remote.
42" 42HPX95 $3,500, TTM Aug 05
50" 50HPX95 $4,500, TTM Sep 05

TheaterWide line
New chassis, SoundStrip Speaker System, 720p True HD, CableCARD slot, TV Guide On Screen, PC input, TTM Aug 05.
42" 42HP95 $3,000 (also listed as $3,500)
50" 50HP95 $4,000 (also listed as $5,000)

Custom Series
42" 42DPC85 $2,000, TTM Sep 05, True Monitor ED, SoundStrip speaker system

V, Inc.
VIZIO
Current model price cut (Oct 05)
50" P50HDM $2,700, 1366x768, 1000 ANSI lumens, DCDi, 10,000:1 CR, 15-pin D-sub VGA, 2 component, 2 HDMI, built-in speakers, tabletop stand, universal remote.

2006 line
42" P42HDTV $1,800, TTM Mar 06, HDMI/HDCP, 768x1024
50" P50HDTV $2,700, TTM Jun 06, HDMI/HDCP, 1366x768, DCDi

LCD-TV Panels

Akira
46” HLT460W, 1080p, component, D-sub, $TBA, TTM TBA.

BenQ
30” DV3080, 1280x768, DVI, $4,000, TTM Jan 05.

Hisense
Sep 05
One of China’s top five electronics manufacturer.
ATSC tuners, DCDi, 3:2 Pull-down
22” – 55” (5 models)

Hitachi
May 05
HDL52 series
NTSC/ATSC tuners, Super In-Plane Switching (S-IPS), VirtualHD(TM) video processor, anti-reflective screen, 20-watt integrated speaker system with SRS(TM) Sound Enhancement, multiple aspect modes, split screen, computer inputs and 1366x768 resolution.
26” 26HDL52 $2,000, TTM Aug 05
32” 32HDL52 $2,700, TTM Sep 05
37” 37HDL52 $3,500, TTM Oct 05

UltraVision® CineForm(TM) Director's Series(TM)
32” 32HLX61 $3,800, TTM Jun 05, Hitachi's top of line, VirtualHD(TM) 1080p video processor, dual HDMI, dual IEEE-1394, Learning AV NET III IR system integration, Illuminated Roll & Click(TM) remote, Day and Night Memory by Input with Timer, photo file card USB input, parental locks and an Audio Video Control Center, high gloss black cosmetics.

HP
Advanced Digital Media Television
6000:1 CR, 6ms refresh rate, 176-degree viewing angle
32” LC3260N
37” LC3760N, includes a digital media receiver for a home network

Humax
Oct 05
40” $3,700, TTM Dec for UK, 40GB DVR, DVI, 2 Freeview over the air tuners (UK OTA), right photo

JVC
Sep 05

LCD panels 1366x768 WXGA, ATSC/Cable CARD tuners, dual IEEE-1394, 2 HDMI, 4th generation DIST that upconverts all inputs to 770p, GENESSA 32-bit CPU for enhanced picture refinement, Dynamic Gamma Control Circuitry and home theater features that include TheaterPro D6500K Color Temperature, Digital Noise Clear circuitry, Interactive Plug-in Menu, XDS ID display, and Natural Cinema 3-2 pull down with on/off capability for all telecine sources.

26" LT-26X776 $2500
32" LT-32X776 $3300
37" LT-37X776 $4100
40" LT-40X776 $5000

40" LT-40FH96, TTM fall 05, 1080p, ATSC/CableCARD, dual HDMI, dual IEEE-1394, memory card for Microdrive, universal remote.

2006 lines
1080p
1920x1080p, 5th generation DIST, Genessa 32-bit CPU video processing, 2 HDMI, PC input, 2 component, new ATSC/DRC/QAM/NTSC tuning system, 2 IEEE1394, parametric equalizer.
40" LT-40FN97 $3,800
46" LT-46FN97 $4,600

768p
1366x768, 5th generation DIST, Genessa 32-bit CPU video processing, new ATSC/QAM/NTSC tuning system, HDMI, 2 component (except 26"), PC input.
26" LT-26X787 $1,400
32" LT-32X787 $1,900
37" LT-37X787 $2,500

New LCD capable to display at 120Hz high-speed, TTM end-06.

LG
The company announced seven fully integrated HD models, all at 8ms response times, Super In-Plane Switching with 178 degree viewing angles and XD Engine video processing.

Two 37" HD, TTM March, component, RGB, HDMI, 768p
37" 37LB1DA $3,300, ATSC tuner, Digital Cable Ready (DCR), TV Guide On Screen
37" 37LC2D $2,700, Non-DCR, ATSC tuner, PSIP guide

One 37" under the Zenith name brand
37" $2,300, TTM September, ATSC tuner, NO CableCARD tuner.

32" 32LC2D $2,000, 768p, TTM 06, HDMI, component, RGB

Three 42” models TTM March, 1366x768, XD Engine, HDMI, component, RGB:

42” 42LB1DRA $4,500, 160GB DVR, ATSC/CableCARD tuners
42” 42LB1DR $4,000, 160GB DVR, ATSC/CableCARD tuners
42” 42CD2D $3,500 TV/appliance channel distribution, ATSC tuner, NO DVR, NO CableCARD

47” 47LB1DRA, $ TBA, 1920x1080p, TTM Aug 2006, dual ATSC tuners/Digital Cable Ready, dual HDMI, IEEE-1394, 160GB HD-DVR,

14-bit video processing, TV Guide On Screen (above).

55” 55LP1M, $15,000, TTM 4Q05, monitor, 1080p, 2006 XD engine, HD-DVR, dual HDTV tuners, 1200:1 CR, 500 cd/m2 brightness, Super In-Plane-Switching (Super IPS) for fastest response time, 178 degrees angle view, DVI/HDCP (right).

LG made a demonstration of a pair of 3-D 42” LCD panels

NIKADA
July 05
26” $1800
32” $2250
37” LD1371 $3480

Norcent
CES
VION
TTM Jan 06, 1366x768, 1000:1 CR, 550 cd/m2 brightness, 8ms response time
20" LT-2090 $700, NTSC tuner, component
27" LT-2790 $1,000
32" LT-3290 $1,500, ATSC/NTSC tuners, HDMI
42" LT-4290 $3,000

NUVISION
(Sep 05)
Five models
NiDO circuitry, 1000:1 CR, 10 ms, 500 cd/m2, 1366x768, DVI/HDCP
26" NVX26HVU $1500, TTM Sep
32" NVX32HVU $2300, TTM Sep
For later 2005
23" NVX23HVU
37" NVX37HVU
45" NVX45HVU

Panasonic
2006 LCD televisions
ATSC/NTSC/QAM tuners, 1366x768
LX60 series
23" TC-23LX60, $1,000 TTM May 06 (Non-Digital Tuner)
26" TC-26LX60, $1,400 TTM Mar 06
32" TC-32LX60, $1,800 TTM Mar 06

LX-600 series
2 HDMI, TTM Mar 06, HDAVI
26" TC-26LX600 $1,500
32" TC-32LX600 $1,900

Philips
Models announced Sep 05
Pixel Plus 2 HD technology optimizes sharpness, and more natural color and detail, NTSC/ATSC/QAM tuners Cable CARD.
32" 32PF7320A $2000
37" 37PF7320A $2800
42" 42PF9730A $3500
42" 42PF9830A $4000, AmbiLight 2

2006 line at CES
The company announced their next generation AmbiLight equipped HD LCD panels that emit ambient light around their frame using colors that match the dominant colors appearing at the screen to reduce the eyestrain and expand the scene/image improving perceived picture detail and contrast (AmbiLight Surround at left/top/right, AmbiLight Full Surround on all sides). Philips is also featuring this on their new plasma line. Clear LCD backlighting technology designed to speedup response time, reduce motion blur, improve contrast, and boost light output, strobes LCD hot cathode florescent backlighting, and fire pixels only as needed to eliminate motion smear.

37" 37PF9631 $2,300, TTM June 06

42" 42PF9731 $3,000, TTM July 06
42" 42PF9831 $4,000, TTM July 06, flag-ship, 4-side AmbiLight full surround

MiraVision
32" and 42" LCD panels that feature a reflective mirror when not in use, hides electronic wires

Proton
Purity premium line
ATSC/NTSC tuners (except the 32" with only NTSC tuner), HDMI, antiglare screen, 176 degrees viewing angle (horizontal/vertical), 1366x768.
32" LX-32B6C2(B) $1,700, TTM now
37" LX-37A6C2(B) $2,800, TTM now
42" LX-42A6C2(B) $TBD, 1Q06
47" $TBD, TTM 2Q06
55" $TBD, 2Q06

Proton plans to have the larger screen models also in 1080p by special order.

Proview
32" RX-326 $950, 1366x768, HDMI, component, VGA for PC, no ATSC tuner, but NTSC tuner included, 595:1 CR (ANSI checkerboard), 32 pull-down,

Runco
CR-40HD $7,000, 1366x768, 4.5 " deep.

Sanyo
TTM 3Q06, ATSC, QAM clear tuners, HDMI, 1366x768
26" SLT-2676S
32" SLT-3276S

Samsung
Two HDMI, Game Mode feature eliminates image delay by bypassing video processing circuitry, enhances sound and boosts detail in dark areas, Super-Patterned Vertical Alignment (S-PVA) panel increases horizontal viewing angle to 178 degrees and improves color gamut reproduction from 72 percent to 92 percent. The technology will add about a $200 price premium to unit cost.

92 Series
TTM Apr 06, 1366x768, 5000:1 CR, 2 HDMI
32" LN-S3292D $2,300
40" LN-S4092D $3,500
46" LN-S4692D $4,500

96 Series
1080p, USB 1.1, 6000:1 CR, IEEE1394, ATSC/Cable tuners
32" LN-S3296D $2,500, TTM Apr 06
40" LN-S4096D $4,000, TTM Aug 06
46" LN-S4696D $5,000, TTM Aug 06

82" LN-S8297DE (right), 1920x1080, DNIe chip, 7000:1 CR, with LED backlight, 8ms response time, HDMI, factory statement LCD panel.

51 and 52 Series
4000:1 CR, ATSC tuner, 170 degrees, 2 HDMI
26" LN-S2651D $1,700, TTM Mar 06, black (52D in white)
32" LN-S3251D $2,100, TTM Mar 06, black (52D white)
40" LN-S4051D $3,300, TTM Apr 06, piano black (52D pearl white)

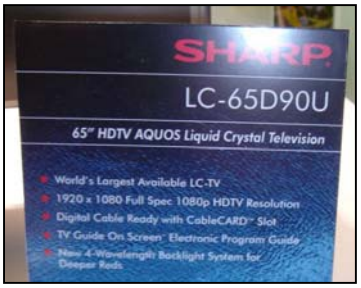
Sharp

D4U and D6U series
1366x768, 450 c/m2 brightness, 170 degree angle, Quick Shoot 12 ms response time, 800:1 CR, ATSC/CableCARD tuners, TTM now.
26" LC-26D4U $1,700
32" LC-32D4U $2,400
37" LC-37D4U $3,500

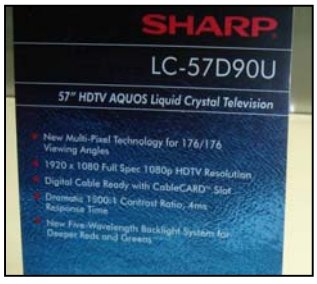
26" LC-26D6U $1,700
32" LC-32D6U $2,500
37" LC-37D6U $3,600

45" models price drop (Oct 05)
TTM Oct 05, TV Guide On Screen, 1080p, removable table stands, CableCARD, 450 cd/m2 brightness, 800:1 CR, HDMI and DVI, 170 degree angle viewing, 12ms response with Quick Shoot video circuitry.
LC45GD5U $6,500, black lacquer finish
LC45GD7U $6,500, titanium finish

D90U Series



65" LC-65D90U, $21,000 (right), TTM Nov 05, AQUOS 1920x1080p, same specs as 2005 report, ATSC & Cable CARD tuners, four-wavelength backlight system, 800:1 CR, 450 cd/m2 brightness, DVI-I, IEEE-1394, Quick Shoot video circuitry, 12 ms response time, TV Guide On Screen free interactive programming guide, titanium finish, detachable stand and bottom speakers (specs above on left).



57" LC-57D90U, $16,000, TTM Mar 06, AQUOS 1920x1080p, ATSC & CableCARD tuners, new five wavelength backlight system, multi-pixel

technology that produces a contrast ratio of up to 1,500:1, enhanced Quick Shoot video circuitry for 4ms response time, wider viewing angles (176 degrees), dual HDMI, HD component, DVI-I, DTVLink, titanium finish, detachable bottom speakers (57" LCD display above with specs).

Multi-pixel technology for 1200:1 CR, 6ms response time, 176 degrees viewing angle, 4-wavelenght backlight system, HDMI, HD component, DVI-I for PC, DTVLink, titanium finish, TTM May 06.
32" LC-32D50U $2,300, 1366x768
37" LC-37D90U $3,500, 1080p
45" LC-45D90U $5,000, 1080p

PT90 AQUOS Series
TTM May 06, multi-pixel technology for 1200:1 CR, <6ms response time, 176 degree viewing angles, CableCARD tuner, dual HDMI, HD Component, DVI-I for PC, DTVLink inputs, detachable stand and bottom speakers (37" and 45" only).
32" LC-32PT50U $2,300, 1366x768, fixed bottom speakers
37" LC-37PT90U $3,500, 1920x1080p, new four-wavelength backlight system
45" LC-45PT90U $5,500, 1920x1080p, new four-wavelength backlight system

D40U AQUOS Series
TTM Mar 06, 1366x768, ATSC/CableCARD/NTSC tuners, widescreen, 1200:1 CR, 6ms Quick Shoot video circuitry, 176 degree viewing angle, piano black finish, detachable table stand for wall mounting, fixed bottom speakers.
26" LC-26D40U $1,300
32" LC-32D40U $2,000
37" LC-37D40U $3,000
45" LC-45D40U $4,000

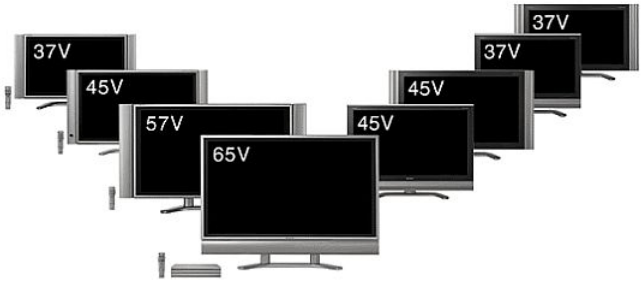
SH20U Series
TTM 2H06, affordable line, 1366x768, 800:1 CR, 12ms response time, 170 degree viewing angles, HDMI, HD component, NTSC/ATSC/QAM tuning.
26" LC-26SH20U $1,100
32" LC-32SH20U $1,800
37" LC-37SH20U $2,700
42" LC-42SH20U $TBA

82" 1080p factory statement panel shown at CES; very limited distribution starting Summer 06.

Sharp also demonstrated Two-way viewing angle LCD 45" commercial panels and 7" for automotive applications (in production) as technology statement (right):

In January 2006, Sharp introduced two new lines of LCD panels in Japan the G and B Series with HDMI/HDCP, DVI/HDCP, iLink, 176 degrees of viewing angle.
B Series
37" LC-37BE1W
37" LC-37BE2W

45” LC-45BE1W, 1080p
45” LC-45BE2W, 1080p
G Series
37” LC-37GE2
45” LC-45GE2
57” LC-57GE2
65” LC-65GE1



Sony
CES
The company demo and announced a variety of BRAVIA LCD panels

There will be two series:
Both w/ATSC integrated tuners, redesigned remotes and direct-input access, 1366x768, HDMI, component, PC inputs.

BRAVIA U series
32” KLV-32U100M $1,700, TTM Feb 06
40” KLV-40U100M $2,800, TTM Mar 06

BRAVIA S series
With S-PVA technology for improved video angles
32” KDL-32S2000 $2,000, TTM Mar 06
40” KDL-40S2000 $3,000, TTM Mar 06
46” KDL-46S2000 $4,500, TTM May 06 (1080p)
26” and 23” models as well

BRAVIA XBR
Advanced Wide Color Gamut-Cold Cathode Florescent Light (WCG-CCFL) backlighting system, 1366x768, ATSC/CableCARD tuners, HDMI, component, PC input, USB.
26” KDL-V26XBR1 $2,000
32” KDL-V32XBR1 $2,700, SPVA
40” KDL-V40XBR1 $3,500, VGA, SPVA, 1300:1 CR

82” BRAVIA LCD panel prototype was demo as a technology statement using Triluminous LED backlighting (right):

Syntax
Oleiva
42” LT42Hvi, $3,700, TTM Jun 05, integrated ATSC/NTSC, HDMI/HDCP, 1366x768, 8ms, 1200:1 CR, 800 nits.

CES
Three new families of LCD panels on 20”-47” sizes, TTM 1Q06:

1) Syntax Select LT-HVN entry line with 20, 23, 26, 27, 32, and 40 inches
2) Oleiva HVX and HVE classic line with same sizes and a 42”

3) Oleiva Signature 1080p LT-HVi Ultra premium line with 37, 40, 42, and 47 inches, using HQV Silicon Optix Realta chip, ATSC/NTSC tuners, 2xHDMI, 3xcomponent, VGA, all glass front with antireflective coatings, 1600:1 CR, 800cd/m2.
The 42" (LT42Hvi $3,500) and 47" (LT47Hvi $4,000) are expected by 2Q06, and are said to support 1080p inputs.

Thomson (RCA)

2006 line

Eleven new models under RCA brand, 26" and larger, ATSC tuner, HDMI, component, 1366x768.

26" 4 models (entry model L26WD12 $900 TTM Apr 06; top of line w/DVD player L26WD131D $1,200, TTM May 06)

32" (entry model L32WD12 $1,100, TTM Apr 06; top of the line w/integrated DVD player L32WD131D $1,500 TTM May 06)

37" (entry model L37WD12 $1,600, TTM June 06; top of line w/integrated DVD player L37WD132D $2,000, TTM July 06)

Monitors on 15", 20", and 23" will continue (no tuners).

Toshiba

The company decided to use the CES show to make announcements that usually are done at their dealer show in spring. The company is investing in LCD and SED in 2006, while also carrying plasma as a mainstream product. Toshiba is abandoning the CRT RPTV line this year.

New models at 1080p resolution

Response time reduced from 12ms in 2005 to 6-8 ms now, video processing from 8-bit to 12-bit with 4096 gradation levels in 2006.
42"
47"

Cinema Series LCDVD category

Integrated with built-in DVD, 720p True HD panel resolution, CableCARD Slot, TV Guide On-Screen, dual HDMI(TM) digital inputs, and a PC input, SRS(R) WOW(TM) for enhanced sound quality, Digital 3DYC Comb Filter, Cinema Mode (3:2 Pull Down), Color Temperature Control, HD Dynamic Contrast, and Movie and Sports modes.
32" 32HLX95 $3,000, TTM July 05
37" 37HLX95 $4,000, TTM Aug 05

TheaterWide line
720p, HDMI
27" 27HLV95 $2,000, TTM July 05, Integrated
27" 27HL95 $1,800, TTM July 05
32" 32HL95 $2,500, TTM July 05
37" 37HL95 $3,500, TTM July 05

In February 2006, Toshiba announced in Japan "REGZA" their new brand name to be used on all of Toshiba's flat-panel TVs that incorporate the company's proprietary "PixelPure" high-bit image processing technology. Initially the name would be applicable to LCD panels (which use PixelPure, plasmas do not).

In the plan, 11 LCD panels will be introduced on March 1 in Japan between 26" and 47" using the REGZA name. The use of the "Cinema Series" naming for selected products does not interfere with using REGZA naming for PixelPure products.

SED, using the PixelPure technology, would be expected to also use the REGZA naming when the first SED products are out later in 2006, but it was not confirmed by Toshiba.

V, Inc.
VIZIO
Nov 05
37" L37HDTV $1,500, 1366x768, 8ms response time, ATSC/NTSC tuners, 3:2 pulldown, tabletop stand, powered speakers, universal remote, PIP, HDMI, HD component, 15-pin D-sub RGB.

Viewsonic
2006 line
32" N3260w $1,300, TTM Jan 06, 1366x768, HDMI, RGB, ATSC tuner, component
37"
40" N4060w $3,300, 500 nits, 800:1 CR, 1366x768, 170 degrees viewing angle, 10ms response time, HDMI/HDCP, ATSC/NTSC tuners, PC input via HDMI and VGA.

Westinghouse
PC monitors, the 37" and 42" LCD are tuner-less monitors and comply with the FCC ATSC tuner mandate because they omit NTSC tuning, they are true monitor products. All include DVI, and component video.

30" LTV-30w2 $1,200, NTSC tuners (June 05)
32" LTV-32w1 $1,600, NTSC tuners (June 05)
37" LVM-37w1 $2,300, 1080p panel, accepts 1080p on DVI and VGA, no tuners
37" LTV-37w2HD $1,700, TTM Feb 06, 1366x768, ATSC/NTSC tuners
40" LTV-40w1HDC $2,100, TTM Mar 06,component, ATSC/NTSC tuners, 1366x768
42" LVM-42w1 $N/A, monitor no ATSC no NTSC tuners,
42" LVM-42w2 $2,800, TTM Jan 06, 1080p, DVI, component, no tuners
47" 1080p

CES

The company said they demonstrated the world's largest ultra high resolution LCD with 8 million pixels. I could not witness the demonstration.

56" 3840x2160, 8 ms response time, 600-nit, 1000:1 CR

1080p into HDTV Displays

What are 1080p manufacturers doing on their current 1080p sets? Are they really implementing all what 1080p can and should do? Do people need all what 1080p can do? When? How could one find out if a set is actually suited to be ready for near future 1080p media, such as Hi Def DVD coming in a few months?

I will cover all those subjects gradually in short articles in the HDTV Magazine, but first let us mention a couple of key points.

1080p resolution quality in displays, processors, players, recorders, pre-recorded media, etc. is rapidly becoming the next stage of this HDTV industry; the 1080p buzzword has been also loosely used to identify the "new breed of top quality HDTV sets." In order to be actually ready for such level of quality throughout the HD system, digital display devices that claim 1920x1080p capabilities should be designed and suited to accept 1080p/24/30/60 fps signal from an external 1080p progressive source.

Not accepting 1080p from an external source will force the source to supply a 1080i version to the TV which would do the 1080p upconversion job with its internal/proprietary de-interlacer circuitry, typically not as good as one should expect of equipment at this level of resolution.

Regarding deinterlacing, do these new 1080p sets deinterlace properly 1080i? What happens when is not properly done and you still want that TV? One option could be to take that deinterlacing job outside the TV so a dedicated video processor can improve it. However, if the TV does not accept 1080p, such limitation would preclude the use of a higher-quality 1080p video processor/scaler, which usually is expected to perform better 1080p upconversion, such as Faroudja, DVDO, Lumagen, or the Dragon Fly scaler/noise reduction implementing the new Silicon Optix "Realta" chip (a professional video technology originating from Teranex), among others.

Most people would consider irrational to spend $2000 on a 1080p video processor to feed a $3000 1080p HDTV just because the TV is weak in that area, but other people might consider the option of having 1080p inputs an important future proof feature that would allow the component approach for upgrading the overall quality of the HD system where and when is needed.

Separating the video processor from the display device to follow individual upgrade paths could be a good solution, especially for front projectors/large projection screens; the processor might be software upgradeable, while many HDTVs usually are not. An owner of an otherwise good 1080p HDTV display might not like how the set handles the internal 1080p video processing that cannot be upgraded.

The higher quality of 1080p opens the opportunity to sit closer to the image and open the angle of view, which would immerse the viewer into a cinematic experience by enhancing the peripheral vision without sacrificing resolution; it also provides the possibility for using larger screens for a home theater environment.

However, viewing non-1080p content on a 1080p HDTV set that might have insufficient quality to properly upscale, deinterlace, and/or upconvert, could certainly produce a variety of video artifacts that would actually force the viewing position to

be further back to avoid seeing them, which is the case of many of the first generation 1080p TV sets introduced over the last year; upgrading to a larger screen could accentuate the visibility of those artifacts.

Additionally, in many viewing situations the higher quality of 1080p resolution might not be noticed as an improvement by people accustomed to view the TV just as the typical TV box from far away; for those, a 1080i, or 720p, or even a 480p ED level DTV could be all they should need. In other words, some people driven by the 1080p bug of "more is better, and I have to have it" might be paying extra for 1080p resolution they would never be able to see as an improvement on their room/viewing conditions.

The next part takes a look at an example of how some 1080p rear projection HDTVs are being implemented; on our first case we will step behind the technical curtain of Syntax-Brillian's new 1080p set.

1080p by Brillian

Following with the subject of 1080p, this is the second part of the series of articles about the technology we will publish in the HDTV Magazine. Today we will look behind the curtain of how Brillian had implemented their 1080p magic into their recently released LCoS rear projection set.

The company recently introduced their 65" 6580iFB 1080p LCoS set, which was slated to become available in 4Q05 and was the only size Brillian was planning to carry in 2005. Brillian indicated that the video processing was implemented to get to the viewer all the resolution the 1920x1080 chip can promise, even with non-1080p sources.

During July/August of 2005, we held several technical exchanges with Vincent Sollitto (President and CEO), Hope Frank (Vice President of Marketing), and their technical team, continued with some meetings at the HDTV Display Search Conference held in Beverly Hills in late August, and culminated in January 2006 with a visit to their suite at CES to discuss with their engineers.

Although I have seen the RPTV myself in several opportunities, the following material should not be misinterpreted as my endorsement of the product, or a technical confirmation of some of the statements provided by Brillian.

The material might be more productive if the reader first becomes familiarized with the basic HDTV concepts of interlace and progressive I covered on other articles and the HDTV Glossary of this magazine; otherwise the information below could be a bit more technical than a casual reader might be comfortable with. However, the subjects are covered with a tutorial approach, and are intended to help any reader to be acquainted with the concepts surrounding 1080p.

Upconversion to 1080p

This 1080p set displays images at 120 fps; in Brillian's opinion the image quality obtained at that frame rate is much better than just 60 fps, which is typically what most other 1080p sets do. The video processor does not perform motion adaptation when jumping the frame rate from 60 to 120 fps; Brillian considers it unnecessary.

480i (NTSC) Inputs: Brillian uses pixel-by-pixel motion adaptive deinterlacers with 3:2 cadence detection and compensation combined with advanced low angle interpolation to produce a 720x480p image. According to Brillian, this conversion process is as good as any in the industry today.

Brillian then uses the highest quality scaling filters to upscale the image to 1440x1080, preserving the aspect ratio and converting from rectangular to square pixels. If the user chooses one of the non-standard aspect ratios, the conversion will change to compensate. For example, widescreen content viewed in the widescreen aspect ratio will be scaled horizontally to 1920, performing a one third stretch and converting from rectangular to square pixels.

1080i Inputs: As many current 1080p HDTV manufacturers do, Brillian treats 1920x1080i video as 1920x540p frames. According to Brillian, to differentiate its set

from the competition and ensure the highest quality 1080p image is presented; Brillian uses a proprietary set of sophisticated scaling filters to vertically scale the 1920x540 fields to 1920x1080.

As the next generation of image processors become more mature, the next generation 1080p units will incorporate hardware to perform the same high quality pixel-by-pixel motion adaptive deinterlacing on 1080i inputs Brillian currently only uses on 480i inputs. Brillian stated: "Our next generation of products with pixel-by-pixel motion adaptive deinterlacing of 1080i sources will be brought to market when they are mature and don't cause more issues than they solve."

Progressive Inputs: Brillian accepts the standard 480p and 720p video formats as well as a multitude of PC formats such as VGA, SVGA, XGA, SXGA, and 1080p. Brillian uses the highest quality scaling filters to convert these images to the 1920x1080 panels with options to preserve the aspect ratio or fill the screen.

A note on scaling filters: Brillian does not use simple interpolation to scale the incoming data to fill its panels. Interpolation, even the more advanced techniques, can cause loss of detail and in general have uncontrolled effects on the images. Brillian uses up to 320 tap FIR filters to perform the image resolution conversion. The use of FIR filters allow for control of the resulting image sharpness, which Brillian provides as its Picture Filter Modes. Additionally, these scalers are multiregional, allowing for non-linear scaling to execute Brillian's Extended aspect ratios.

Deinterlacing Implementation

Brillian does not add special artificial frames not intended by the material authors, however unless the image already comes externally as 60 fps, the set would have no other choice than to create 60 progressive frames from the provided 60 interlaced fields using pixel by pixel motion adaptive deinterlacing (480i).

Further, if the original material was 24fps from film, then the 60 interlaced fields need to be converted to 60 progressive frames using inverse 3:2 pull-down. Given such video processing, I questioned if the pixel-by-pixel motion adaptive deinterlacing is also used for the added frames, in addition to the motion adaptation used for joining the fields.

They clarified that in their view 1080i deinterlacing is really no different than 480i deinterlacing and follows the same rules or patterns. Standard video sources (those recorded interlaced) are handled by combining each field with the previous taking into account motion to prevent combing or blurring effects.

If the 60Hz interlaced source has the following fields A, B, C, D, E, then the process produces progressive frames 1-4 which are 1 (a combination of fields A and B), 2 (a combination of fields B and C), 3 (a combination of fields C and D), 4 (a combination of fields D and E) and so on.

In some sense, blending these fields together does produce images unique from the original material but motion adaptive deinterlacing should further reduce the artifacts generated by the process. By how much and if it will be noticeable at all will highly depend on the content. The result is something close to what would be viewed on a

phosphor based monitor where only the lines contained in each of the fields are actively driven and decay while the other lines are driven on the next field.

Film sources at 24Hz have progressive frames A, B, C, D. These sources are converted to 60Hz interlaced formats (like 480i and 1080i) by showing half the lines (odd) of A, then the other half of the lines (even) of A, then the first half of the lines (odd) again of A, then half the lines (even) of B are shown, followed by the other half of the lines (odd) of B, etc. So the 60Hz fields sequence is A odd, A even, A odd, B even, B odd, C even, C odd, C even, D odd, D even.

According to Brillian, the proper way to deinterlace this content is to merge the even and odd lines of A to form one progressive scan frame and show it once for each original interlaced field or 3 times for A, C and correspondingly 2 times for B, D. The de-interlaced 60Hz outcome results in the original film frames being shown A, A, A, B, B, C, C, C, D, D.

Therefore, 60Hz is always derived without adding unique frames. Certain frames are repeated for film sources, but they are not altered just repeated. This ensures that the Brillian image quality remains as the author intended, versus trying to combine the fields from two separate frames of film material, which would create unintended blurry images.

The 1080p set does not do 3:3 video processing to display 72 frames from 24fps sources, but rather upconverts the 24 to 60 fps (Pioneer Elite plasmas are known to have the 72fps capability, more suitable for displaying film based content)

1080p Acceptance

Brillian reassured that their 1080p set is capable to accept an external 1080p signal on its digital (DVI) input, as 24, 30, or 60 fps. The set‘s hardware can support 1920x1080p 24Hz and 30Hz ATSC standards. This includes the transmission of the video data to the display section without altering the resolution of the 1920x1080p image.

An accepted 60fps 1080p signal is passed to the display as is without video processing, however, 24fps and 30fps DVI inputs are currently frame rate converted to 60fps using a video buffer with some loss of temporal/spatial resolution pixels due to video processing (about 30%). Future software upgrades may overcome this performance degradation. As these sources become readily available, Brillian’s software can be upgraded to take full advantage of this hardware path (more on it further down).

The TV’s hardware can support 1920x1080p at 24Hz and 30Hz on the VGA and High Definition Component inputs. However, 60Hz 1920x1080p analog sources will be too fast for the system. The A/D converter itself is only 140MHz, so the VGA 148.5MHz standard will not run cleanly. All the circuitry past the A/D converter is fast enough for 1080p 60Hz at 148.5MHz, up to and including the display’s pixel matrix.

If the source of the material supports the CEA standard timings for 1080p at 24Hz or 30Hz, the set will be able to display this format. However, since analog sources are not data enabled like DVI/HDMI, the source needs to provide the correct timing formats or else the data will not be detected and displayed properly.

It is important to note that although I am very specific on quoting some limitations on the way this set accepts 1080p (because readers looking for that feature deserve honest detail), the fact that the set actually accepts 1080p is putting this set in a very unique class of only a couple of first generation RPTV sets available today. Brillian has made the effort to provide 1080p inputs on this first generation and that has an important future-proof value that most other manufacturers could not match on their recently released 1080p sets, although some have already announced their plans to provide such feature in the near future.

Upgradeability

As these 24Hz and 30Hz 1080p sources become more prevalent the Brillian software may need to be updated to support all the nuances of the video timing, but the hardware platform is in place.

Brillian's current thinking is that there are so few devices providing material at this resolution and rate today that it is difficult to predict if they become more common and if the external sources will continue to conform to the standards. Given this, Brillian said that software updates are available.

When inquiring about Brillian's plans of software upgradeability for TVs that were purchased with the current software, and how they could investment-protect consumers who buy the first generation 1080p model, the response was: "Brillian provides the new firmware on its website for home service technicians and home installers to access and install for customers who require the upgraded features. The User's Manuals are also available to support the new firmware on the same web site."

Brillian is working on the next generation video processing for 1080i deinterlacing to 1080p; the company indicated that they have no details as to how future hardware/software solutions for this feature would be implemented in current models, "if" it can be implemented as an upgrade.

Integrated Tuners, FireWire, ISF, etc.

Although the following items are not necessarily related to the 1080p subject, consumers interested on this 1080p set might want to know how certain features are implemented.

Regarding tuning and connectivity capabilities, Brillian's 1080p set was suited with simple ATSC and Cable QAM on-the-clear tuners to meet basic tuning capabilities. The CableCARD option was not pursued after an initial effort when finding out of the need to redo both tuner and Card to suit them for bidirectional capabilities, when implemented later.

The 1080p set does not have 1394 connections even though the hardware can support it from a design standpoint. Brillian considered that the integrated basic tuners are not usually what customers of this type of TV use for HD reception, they typically use a Cable or OTA STB, which should have 1394 outputs to facilitate HD external recording (on D-VHS for example), in addition to possibly have integrated

HD-DVR capabilities for time-shifting purposes. The inclusion of 1394 interfaces on the second-generation sets will depend on market demand.

Brillian also showed at their CES suite a demo of a technology demonstration of a prototype 65" 1080p set that was actually a monitor configuration with a variety of external video processors showing how each performed 1080i to p deinterlacing. This concept will offer videophiles the ability to have a true video system of components as audio does today. Brillian also provided some insight into the performance achievable in future models, they also declared to be happy with the performance of the Silicon Optix chip.

The model that is in production has the ability to perform a wide variety of ISF calibration functions from the user menu (which could also be locked out to avoid accidental changes); there is no need to go to the service menu for the access to that functionality (as with other manufacturers, if they do provide access at all). Some adjustments include selection of color palette (e.g. PC levels at 0-255 gray shades and TV levels at 16-235), 3 color-temperatures (normal 8500 Kelvin, cool 13000, warm 6500) that are also adjustable, sharpness filters, picture modes for each input, etc.

All typical menu settings such as contrast, brightness, etc., are set at halfway levels out of the box, as opposed to what many competitors do, usually cranking up the contrast and other settings to impress favorably on fluorescent lighted retail floors; many uninformed consumers continue using those settings at home, not obtaining the best image the set could provide at the home environment.

It also features a 200-page user manual I have not seen yet but quoted of exceptional clarity. Upon purchasing this TV, an ISF (Imaging Science Foundation) technician visit is also included to perform calibration service for two inputs, which typically could run in the range of $300-$500 if hired separately; such feature is certainly an innovation among the competition, and shows that Brillian strives to produce the best quality image the TV could offer to a consumer.

Brillian Moving Forward

According to Brillian, their sets distinguish themselves from other LCoS 1080p manufacturers in the way they employ an analog drive scheme with their pixel array, giving a much better result with less noise and contouring artifacts than the other digital implementations, such as JVC's DILA. It's method of uniformity compensation is also unique and ensures even color rendering across the screen in solid images.

In the words of Brillian: "Pixelworks has been a good partner. They have provided us a quality chip-set and base design kit. Brillian's engineers have invested 2 years to customize the design to extract the distinguishing performance from the system." Today they have a very capable system, which Brillian said is getting good reviews including Best HDTV of 2005 from several industry experts.

Moving forward to next generation designs, Pixelworks, along with all of the major video processor chip designers offer, will offer new chip sets to support the all-important pixel-by-pixel motion adaptive deinterlacing of 1080i sources. Brillian continues to evaluate these chip sets, as well as those from other companies, to insure best in-class performance is delivered.

Silicon Optix is one such company under evaluation. Their market buzz and pixel-by-pixel motion adaptive noise reduction makes Silicon Optix a player to be closely watched, Brillian said. I have watched them and they have certainly progressed quite well judging by the manufacturers adopting their video processing technology since they introduced to the public their Realta chip at CES 2005, read the details at my HDTV Technology and CES 2005 report available at the pages of this HDTV Magazine.

HDTV STBs (Tuners / DVRs)

Many HD-STBs introduced before 2005 are still current, please review the complete information of those products features, specifications, price, and availability by downloading earlier reports from the http://www.hdtvmagazine.com/ web site.

Contemporary Research

Dec 05

IP-HDVR HD Tuner-DVR

Ethernet controllable, RS-232, IR, ATSC/NTSC tuners and cable RF inputs (at the same time), decode clear-cable digital QAM channels, controls an external analog cable box for subscription-based programming, 120 GB hard drive, TV Guide On Screen™, record and display digital video from IEEE-1394 ports, Component, RGB, DVI, Dolby 5.1 surround sound over optical output, variable and fixed-level stereo audio ports, pauses live programming.

Digital Stream

HD 1150 $190, ATSC OTA tuner, component, no DVI, no HDMI, no 1394, RGB and YPbPr output, coax/optical digital audio, 1080i/720p480i/p output.

HD 3150 (Pro Brand) $229, ATSC OTA tuner, 720p/1080i/480p output, component, RGB, simultaneous 480i via composite and S-Video, 16 days Guide, signal strength reading by remote, wide, narrow, and Zoom AR controls, freeze frame, coax/opt audio, stereo analog out, No DVI, No HDMI, No IEEE1394. A product of Pro Brand International, 770-423-7072. http://www.pbigroup.com

DIRECTV

H20-250 MPEG-4 HD Plus DVR, TTM 2Q06, $TBA, records 2 different programs from either DIRECTV or ATSC while watching a pre-recorded program at the same time,

record one watch another, pause and rewind live HDTV up to 90 minutes, instant replay, slow motion, 30 hrs MPEG-2 HD recording, or 50hrs on MPEG-4, or up to 200 hrs of SD. First receiver with interactive capabilities, size of HDD not revealed but said could be similar of current HD DVR, outputs 480i/p, 720p, 1080i, NO 180p, 2 DIRECTV inputs, 2 ATSC tuners, 1 satellite in, HDMI, component, composite, digital/coax out, 2 Ethernet ports, 2 USB 2.0 for future connectivity.

Dish Network

In October 2005, the company finally announced the release of the portable video players I mentioned on my CES report of 2005 (page 87). The players can download and store a HD program from a HD-STB DVR but in SD quality. The specs of these PocketDish products are similar to the specs stated in January 2005; the prices are as follows: $329 for the 2.2" screen w/20GB (AV402E), $499 for the 4" screen w/30GB (AV500E), and $599 for the 7" screen w/40GB (AV700E).

In November 2005, Dish Network introduced a 2Wire HD-STB with dual satellite tuners and dual OTA tuners supporting 480p/720p/1080i output resolutions, 180 hrs of SD, 25 hrs of HD or any combination of the two, trick play, record two programs at once from either tuners, record one watch another, record two live programs while watching another program, EPG w/7 days, VOD push to DVR and NVOD download and play, digital media center to organize and store digital video, music and photos within the HDD or on a network-attached computer, Windows Media 9 DRM, DVI-I, RGB, optical audio out, RJ-45, Wi-Fi 802.11b, USB ports at front/rear, IR receiver.

<u>2006 line of MPEG-2/MPEG-4 models</u>
VIP622 DVR
$300 one-time upgrade for new lease customers which includes a dish and installation, TTM 1Q06, multi-room HD STB that supports 2 TVs simultaneous, one HD at 480i/p/720/1080i and one SD 480i (HD down-converted), stores 180hrs of SD, or 25hrs HD, or a combination of both, 2 satellite tuner inputs, ATSC tuner, 1 UHF Pro remote control antenna input for included antenna, USB 2.0 port, Ethernet port, HDMI, YPbPr component, optical digital audio out, records Dolby Digital, 9 day Picture in Guide widescreen EPG, records two simultaneous programs in HD.

VIP211
$50 for new lease customers, TTM now; supports 1 TV, ATSC tuner, 480i/p/720p/1080i outputs, USB 2.0. 1 satellite tuner input, 1 Ethernet port, HDMI, YPbPr component out, optical digital audio out.

VIP222
Supports 2 TVs, one HD at 480i/p/720p/1080i, one SD at 480i down-converting HD, 2 satellite tuners, ATSC tuner, USB 2.0 port, Ethernet port, optical digital audio out, HDMI, YPbPr component out.

Humax
Humaxusa.com 866 486 2987
HFA100 OTA ATSC HD receiver $229, HDMI, VGA, component.

JVC
The company announced 3 new HD-STBs with ATSC/Dish Network tuning capabilities with MPEG-4, two of those support dual tuner and dual zone, and one is:
TU-VIP622RU DVR with 320 GB.

LG
The company is doing efforts in building D/A converter boxes to facilitate the transition to DTV, see details of how LG is teaming with **Thomson** further below.

In October 2005, LG announced that the company is also launching DirecTV STBs as a leading manufacturer of MPEG-4 STBs; the units are being sold under the DirecTV brand name, have advanced program guide, advanced security, and protected digital outputs (HDMI/HDCP) with simultaneous component/composite output, a general-purpose LINUX-operating-system, and an USB port, are built around Broadcom's MPEG chipset and LG's fifth-generation "VSB" chipset to view MPEG-4 HD satellite broadcasts, current MPEG-2 standard- definition programming, and OTA ATSC (Advanced Television System Committee) digital HDTV and SDTV broadcasts.

The agreement also plans for LG to develop a MPEG-4 HD-DVR model as well as a Home Media Center STB.

MatrixStream IPTV Technologies
The company claimed to have the world's first VOD and IPTV STB using H.264 AVC (advance video codec) adapted for 1080p, 80 GB HDD, only receives SD and HD IPTV signals since it is an IPTV set-top box that receive IPTV signal over broadband.

IMX 1020 HD STB, $TBD, available for trials Jan 06, TTM 1Q06, 1080p over HDMI, H.264, component analog able to output 1080i but subjected to downrez if the content requires it, HDCP over HDMI is activated depending on the content provider contract and STB sold (the boxes are offered world wide so it varies by location). According to the company, the IPTV signal will be always protected by encryption, for the output, it is up to the service provider to decide if they want to turn HDCP on or off depending on the content contract they have for IPTV delivery. Usually a customer will get the set-top box via service provider directly, however, some service providers might choose to provide it over retail, i.e.: Best Buy.

IMX 1100 PC Player available late Jan 06 from http://www.movie99.tv/ , for over 300 free channels from around the world and 150 free DVD and HD quality movie clips.

NTSC/PAL composite
NTSC/PAL s-video
Analog YPbPr / RGB
150 MHz YCbCr / RGB digital video output interface
- 8-bit 4:2:2 YCbCr data
- 16-bit 4:2:2 YCbCr data
- 24-bit 4:4:4 YCbCr data
- 24-bit RGB data (888)
- BT.601, BT.656, or VIP 2.0, "video valid" output signal
- Master or slave timing

According to the company, MatrixStream's solution is generally marketed to broadband providers seeking an opportunity to increase ROI by deploying video over their networks. On the backend, broadband providers have access to one of the most cost-effective, scaleable VOD systems available complete with billing management, subscriber management, channel management, and digital rights management. Moreover, MatrixStream's solution supports industry standard video codecs like MPEG4, VC-1, and H.264 and is fully capable of supporting all future subsequent video codecs.

Reproduce DVD Experience – MatrixStream's IPTV solution is automatically programmed with features currently available on DVDs, including interactive menus, subtitles, multiple audio tracks and video chapters.

- High Definition Video Support – MatrixStream's video viewing clients display DVD and HD videos.
- Video Content Security – MatrixStream offers extensive security measures, including built-in Microsoft DRM (Digital Rights Management) support with the

option to add any 3rd party DRM system. Dynamic watermarking management technology is also utilized to protect content from piracy.

- Advanced Video Codec Support – MatrixStream fully supports multiple industry standard advance codecs such as H.264, MPEG 4 Part 10, and VC-1. MatrixStream designed its IPTV system to support all existing and future subsequent video codecs.
- Dynamic Advertising Module – MatrixStream allows IPTV operators/broadband providers complete control over dynamic ad insertion, targeting viewers based on personal preferences and interests.
- Flexible Viewing Options – MatrixStream supports video viewing on both PC and the IP STB clients. Moreover, STB clients can be remotely upgraded with new releases and additional options. MatrixStream viewing clients can also be ported to third party platforms and OEM STBs.

Downloaded VOD movies provide the best picture quality / H.264 IPTV channels provides the fastest playing performance on the IMX pre-beta PC player, further H.264 VOD instant streaming movies and H.264 instant streaming IPTV channels coming soon."

MatrixStream VOD / IPTV PC Player download and login instructions:

(1) Download the latest pre-beta VOD / IPTV PC Player at:
http://www.matrixstream.com/pcplayer/ or www.movie99.tv
(2) Unzip PC player
(3) Install it
(4) Run program and enter your username, password, and website name

Resolution / Frame Refresh Rates
704/720 x 480i 30Hz
704/720 x 480p 60Hz
704/720 x 576i 25Hz
704/720 x 576p 50Hz
1280x720p 50/60Hz
1366x768p 50/60Hz
1024x1024p 50/60Hz
1920 x 1080i 25/30Hz
1920 x 1080p 5060Hz

Audio Formats
- 16-bit linear PCM with HDCD support
- MPEG-1 and MPEG-2 Layers I, II and III (MP3) 2.0
- MPEG-2 BC multi-channel Layers I, II and III 5.1
- MPEG-2 and MPEG-4 AAC-LC 2.0
- MPEG-2 and MPEG-4 HE-AAC 2.0
- MPEG-4 SBAC 2.0
- Dolby Digital 5.1
- DTS 5.1

Back panel connections
- WMA9@L3 2.0, WMA9 Lossless 2.0, WMA9 Pro@M2 5.1, LAN: 10/100 BaseT, RJ 45
- Connectivity: Two USB 2.0 ports
- Video: HDMI, S-Video, RCA composite, Y/Pb/Pr
- Audio: S/PDIF, Left/Right channel audio output

Video Outputs
NTSC/PAL composite
NTSC/PAL s-video
Analog YPbPr / RGB
150 MHz YCbCr / RGB digital video output interface
- 8-bit 4:2:2 YCbCr data
- 16-bit 4:2:2 YCbCr data
- 24-bit 4:4:4 YCbCr data
- 24-bit RGB data (888)
- BT.601, BT.656, or VIP 2.0, "video valid" output signal
- Master or slave timing

Motorola
DCT6412 III

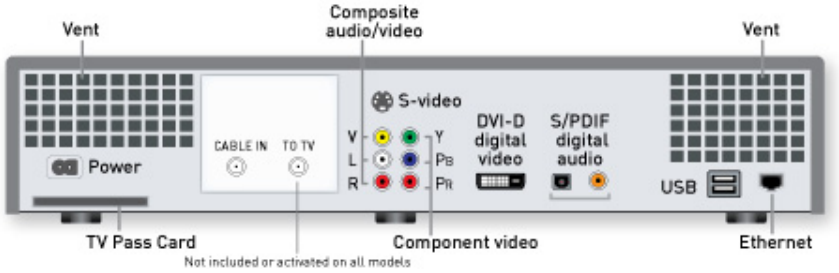
Built-in home media networking capabilities, MoCA, uses existing coax, QAM tuners, video-over-IP, Verizon is first customer with their FiOS TV service in TX, VA and FL.

QIP6416 HD, dual tuner DVR
QIP6200 HD, single tuner
QIP2500 SD, single tuner

Moxi (Implemented by Motorola)
2 HDTV tuners, DVR, right

Moxi Media Room and Moxi Mate (below)

Moxi Back Panel Connections



MovieBeam

Video-on-demand service for standard- and high-definition catalog and new movie releases for playback at any time from a 160GB hard drive. The service includes DVD releases and subscription-free model for movie rental for 24-hour viewing periods for $1.99 for catalog titles and $3.99 for new releases, an extra $1 fee is charged for HDTV titles.

The HDD STB caches 100 movies and sells for $199 after a $50 rebate; $29.99 activation fee, needs periodic connection to a telephone jack, no need for a broadband connection, uses PBS OTA datacasting tuned with OTA antenna.

Movies are sourced from major Hollywood studios, including Disney, 20th Century Fox, Lions Gate Entertainment, Universal Pictures, New Line Cinema, Paramount Pictures, and Warner Bros. Studios (Sony is not a participant).

Ten movies are delivered to the HDD each week, while 10 titles are removed at the same time. Of the 100 downloaded titles to the HDD, at least 10 are 720p HD with Windows Media 9/VC-1 compression at one time, for viewing on HDMI/HDCP-enabled HDTV displays. The other 90 titles are in standard definition, which are upconverted to 720p over HDMI/HDCP for HDTV viewers.

Connections other than HDMI support component video, S-video, composite and audio connection ports including digital coaxial, SP/DIF, HDMI and left/right stereo audio, the service also supports Dolby Digital 5.1, widescreen formats and closed captioning, spending limit, and parental controls.

PX Digital Multimedia

ATSC-1000 OTA HD-STB for HDTV and SDTV packaged with DA-5100 compact outdoor/indoor antenna
http://www.px.com.tw/

Samsung

SIR-T451 $250, TTM now, ATSC 5th generation high-definition terrestrial tuner, includes an LCD display and a DVI output, Dolby Digital 2.0 Stereo or Dolby Digital 5.1 surround audio, selectable outputs for

1080i, 720p, 480p and 480i, outputs 480i simultaneously, allowing connection to an analog TV or standard VCR.

Scientific Atlanta

The STB introduced at CES 2005 with HD recording ability on the HDD DVR / internal DVD format, was introduced again at CES 2006, check page 93 of the CES 2005 report.

The unit has now a model number:

MCP-100

DVR with DVD Recorder/Player is being tested in MSO labs and is expected to enter beta testing soon. The recording abilities are designed to respect key content protection flags including 'copy freely', 'copy once', and 'copy never' tags, Dual DVR recording, Multi-Room™ DVR, High-Definition, DOCSIS and OCAP capabilities, External SATA for storage expansion, Multi-Room DVR feature enables viewers in three other rooms in the home to access content stored on the DVR hard drive.

Thomson

In October 2005, the Association for Maximum Service Television (MSTV) and the National Association of Broadcasters (NAB) announced their selection of Thomson and LG Electronics to each develop prototype OTA digital converter STBs to receive digital signals on conventional analog televisions, which would be used as future products of manufacturers for the implementation of the subsidy plan to help consumers unable to buy new digital sets.

This selection took several months in the making and was made after a comprehensive evaluation of more than a dozen of proposals submitted by other major manufacturers when responding to a Request for Quotation issued in June 2005 by the MSTV and NAB.

Tivo

Series 3 HD

250GB DVR, dual HD recording (300 hrs SD, 30 hrs HD), dual CableCARD slots on back (Multi-stream 2.0 or Single-stream 1.0 variety) to support two signals, six tuners (dual cable tuners, dual NTSC tuners, dual ATSC tuners), can use any pair, supports digital and analog cable, external SATA drive, backlit remote, TTM 06, supports MRV and TTG, coax cable in, coax antenna in, no RCA or S-video inputs, outputs: HDMI, component, composite, optical audio, RCA stereo out, 2 USB ports, 10/100base T Ethernet jack connections, outputs 480i/p/720p/1080i/pass-thru, encodes analog content with MPEG-2, supports playback w/MPEG-4 AVC/H.264 and WM9.

Viewsonic
Nextvision HD12 OTA HD-STB
$400, DVI/HDCP, 480i/p, 720p, 1080i output via remote, NO 1394, component, RGB, optical/coax audio.

Zenith
HDV-420 $260, ATSC OTA tuner, all-format HDTV reception, 1080i, 720p, 480p, 480i, and native output, 4th-generation VSB technology for improved terrestrial/cable reception and noise immunity, component, DVI, RGB 15 pin D-sub.

Hi-def DVD (HD DVD and Blu-ray)

Background

Although this report covers the Hi-def DVD subject comprehensively, please also consult the 2005 Report Hi-def DVD section for information before February 2005, and a complete background of formats, players, discs, audio/video codecs, etc.

I include below a summary of the basic background to facilitate the reading of this report, as follows:

The HD DVD disc is based in two 0.6 millimeter bonded discs, with a capacity of 30GB dual layer (15GB single layer), which Toshiba says can hold up to 8 hours of HD. The Blu-ray disc has a capacity of 50GB dual-layer (25GB single layer) and is constructed with a 0.1 mm optical transmittance protection layer above the 1.1 mm substrate. Both use blue laser technology.

Both formats selected MPEG-2, MPEG-4 H.264, and WMV-9 VC1 as mandatory video codecs and all players must be able to decode them to be compliant. Discs would have to be encoded with at least one of them.

Triple and four layer discs for longer duration were also invented, as well as hybrid discs that would hold the HD and DVD version of a movie in the same disc, which would help consumers, replication, and distribution channels alike.

In October 2004, the DVD Forum and the Blu-ray Disc Association approved mandatory and optional audio formats for both Hi-def DVD standards. Both groups approved Dolby Digital 5.1 and DTS 5.1 as mandatory HD player formats, which also ensure the audio playability of 5.1 multi-channel DVDs when played on HD players. At least one of the audio formats must be included on a pre-recorded disc, at the choice of the content provider.

In the 4th quarter of 2004, Dolby announced its Dolby Digital Plus format, a higher-bit rate enhancement to Dolby's existing AC-3 lossy format. DTS also announced their DTS ++ (named later DTS-HD) capable of higher bit rates, and lossless.

At that time, both Hi-def DVD format groups declared optional the player's ability of decoding the 6.1 channels of DTS. In September 23, 2004, Dolby announced that the DVD Forum decided to include Dolby Digital Plus and MLP Lossless, the core audio technology behind multichannel DVD-Audio, as mandatory audio standards for the HD DVD format.

During 2005/6 more multi-channel audio format decisions and announcements were made, and their mandatory/optional application on Hi-def DVD. The details of that update are covered further below, as well as in the Multi-channel Audio section.

Formats Reconciliation

The reconciliation efforts to unify the two competing formats gained strength at CES 2005, they were HD DVD headed by Toshiba, and Blu-ray headed by Sony. Unfortunately, the efforts failed shortly after, and the two formats were left as heading to a market place war. The history of CE has demonstrated many times that

market place wars are not good for establishing formats or standards, much less for consumers.

Phillips indicated that the war of formats is driven by the goal of collecting future royalties for the standard patents of the adopted format, for many years to come. Additionally, computer companies would produce PCs with drives that go along with the format they support, Blu-ray on Dell PCs for example.

Regarding plants for disc reproduction, it was disclosed an estimate of $150,000 cost for adapting an existing DVD plant to been able to produce HD DVDs, while it would cost about $3 million for the adaptation of the same plant to produce Blu-ray discs. Sony responded by saying: “Blu-ray costs would quickly come down and the difference between costs of the two formats would be minimal.”

According to Shina Abe, who runs the Panasonic replication task for Blu-ray, a test was made to measure the time it takes to produce a Blu-ray disc at a Panasonic plant in CA. It took about 4.5 seconds, and the expectation is to reduce that time to 3.5 seconds per disc.

Regarding combo lasers, a HD DVD single pickup with objective lens was reported to been able to hold 3 lasers (CD, DVD and HD DVD), while Blu-ray objective lens are more complicated and more costly to implement in a similar feature, but it would still possible to make the combo pickup. Check the Universal Player chapter below.

In October 2005, Toshiba declared that they most probably would not put region codes in their HD DVD.

Universal Player

On September 2005, Samsung announced that they were working on a dual format player that would support both HD DVD and Blu-ray in the same unit. At that time, Choi Gee-Sung, Samsung’s consumer electronics chief, indicated that the unit would be made available during 2006. Likewise, Samsung representatives at CEDIA 2005 confirmed the effort, but did not specify how they were planning to deal with the two different discs, nor it was clear if there will be two different laser pickup hardware pieces.

Three months later, another announcement from Samsung confirmed that it was a change of direction. Samsung’s North America senior vice president of marketing, Peter Weedfald, stated: “The rules that govern the organizations touting the different technologies currently bar manufacturers from combining the two standards into a single drive”. An analyst from iSupply, Steve Kovsky, reported that a Japanese CE manufacturer expressed: "Technically it is possible, but at this point, it doesn't look like it will happen, which is a shame, because it will hinder adoption."

Adding to the subject of how Samsung could address a dual format Mr. Weedfald commented: “The conundrum is that you've got two different camps. You've got licensing issues, you've got trademarks, you've got copyrights" he said. "You can't just be on the Blu-ray side and say, '*We will put HD DVD in there*', and the reverse is true. Samsung may make a separate line of HD DVD players to complement the Blu-ray players it plans to release later this year. This would allow Samsung to

support both formats, although not in a single product. The company, however, does not have current plans to do so", he said.

However, LG announced in March 2006 that the players in both formats they planned for release later this year will not be released, instead, the company is planning to develop and release a dual-format player in late summer/early fall "in light of the uncertainty in this early stage of the market for pre-recorded high-definition optical discs", LG's VP Bob Perry said. How this would be possible considering the experience of Samsung above is unknown at this time, one possibility would be that LG has lobbied the format organizations to investigate what changes could be made on standards, licensing, copyrights, to pursue the plan.

Interactivity

A variety of interactivity features was demonstrated by both formats and was very interesting to see how a viewer could perform new and many current functions in superimpose mode, functions than in DVD would require stopping the movie or going to the menu.

Some of those features are the ability to call up picture-in-picture overlaying with the viewed content to run commentaries, download extra content with the player itself, such as video trailers sourced directly from the studios, etc.

HD DVD uses iHD based interactivity layer developed by Microsoft and Disney, while Blu-ray uses a Java-based solution developed by Sun Microsystems. In December 2005, HP, an old member of the Blu-ray board of the Blu-ray Association, announced that it requested Blu-ray to comply with home networking interactivity features (Mandatory Managed Copy and iHD) to be more appealing to computer users and to be included within the near future MS Vista PC operating system, expecting lower development costs and to be similar to the implementation done by HD DVD.

However, the request was not approved because the BD Association did not want to delay further the implementation of the format to add this feature. HP then decided to end its exclusive support to Blu-ray, and support HD DVD as well; in other words, HP is now supporting both formats. The BD Association indicated that iHD functionality could be added in the future, but it will launch the Blu-ray format with the Java based support.

Maureen Weber, general manager of HP's personal storage division confirmed the decision by stating "By joining the HD DVD Promotions Group and continuing work with the Blu-ray Disc Association, HP will be in a better position to assess true development costs and, ultimately, provide the best and most affordable solution for consumers."

MMC technology would allow the content of the High Definition DVD to be copied on a home-server and streaming it throughout the entire home network, although it would not permit unrestricted copying.

Content Protection

The AACS digital rights management system was said to still working on the final specifications, which affect the launching of both formats, even though they have two different format regulating organizations (DVD Forum for HD DVD, and BD Association for Blu-ray).

AACS was jointly developed by a group of companies including Intel, IBM, Disney, Microsoft, Warner Bros., Toshiba, Panasonic, and Sony. The AACS content protection system can revoke a number of levels of devices, and has been quoted by some as problematic.

The Blu-ray content protection system is now integrated by three components:
A) Advanced Access Content System (AACS), also used by HD DVD,
And two other specific to Blu-ray:
B) BD+ to provide content protection renewability, and
C) BD ROM Mark, to control against mass production piracy, mass duplication, and unauthorized copies of pre-recorded media.

The BD ROM Mark is an identifier in Pre-recorded BD-ROM movies produced by licensed BD-ROM manufacturers to disallow playback on unlicensed players, and help control illegal disc replication, when read by a player before the disc will be allowed to play; the ROM Mark is unique per movie title, not per disc.

The BD+ controls the playback on players that have been attacked by updating the security of the player that has been compromised. Players that have not been attacked but still vulnerable would not be affected by this control, in other words if one player of a model line has been attacked the system will disable that player not the entire model line.

The BD Association (for Blu-ray) has now agreed to adopt the Mandatory Managed Copy (MMC) feature as a requirement on the format. MMC is supported by Microsoft and Intel for the copying of video, however, the BD Association rejected the support to iHD for now, as mentioned above.

In December 2005, the HD DVD format spokesman, Mark Knox, stated that Japan would probably be delayed in the launching because of unfinished AACS specifications although it would not affect the timely release on the US, he clarified the reasons to TWICE as follows, and I quote:

“Since AACS is not finished yet, to the point where we can finalize and ship it, that means we are not going to be able to make this year for Japan, that delay, which we don’t believe is going to be that long, shouldn’t impact the delivery of the product in the U.S. in March, and it doesn’t affect the manufacturing of the product, because the changes we need will be made in firmware. Meetings to finalize the remaining issues with AACS are scheduled this month. They just have to take the final votes so they can issue keys, there are some points still under discussion, but I think they are going to reach consensus now on a few items, such as not doing region code, for example”, Knox said.

In a corporate statement, Toshiba said “because the DVD Forum has adopted AACS as an integral part of the HD DVD format, Toshiba will launch its HD DVD products only after AACS is finalized.

As of the first week of January 2006 AACS was still not done. Manufacturer introductions of players as early as March are said to be affected by further delays on these specifications. Most manufacturers consulted at CES about the subject have declared that the 1080i issue over component analog connections and the 1080p output over digital connections are subjected to the completion of those specifications, and to the decisions made by the format regulating organizations, and they would certainly have to comply with those rules when releasing the products (more updates in the following chapter).

AACS Down-Res

In January, 06, the AACS (Advanced Access Content System) consortium, the organization responsible for content protection on the new Hi-def DVD formats, reached an agreement to require manufacturers of the two High Definition DVD player formats (Blu-ray and HD DVD) to suit their players with the ability to reduce the resolution over component analog connections from 1920x1080 to 960x540, one fourth the quality of the image stored in the disc, when responding to a digital flag (Image Constraint Token) stored within the disc movie.

The digital outputs (HDMI or DVI) will still carry the full resolution of the disc because the outputs are protected by HDCP. Component analog connections cannot carry that protection, reason by which the resolution would be downgraded, which would affect approximately 10 million HDTVs sold since 1998 suited only with component analog inputs, and many PC systems of HTPC viewers not suited with HDCP.

The recording studio will supply the digital flag, if the studio sets the flag as off the player would supply full resolution to the analog outputs. The movie package must show if the flag was used on the movie to make the buyer aware upon the purchase.

Manufacturers of players and software (movies) would have to comply with the AACS ruling in order to obtain their license. Fox has not supported the idea; Disney, Paramount, and NBC Universal did support it, it is uncertain if Sony would support it.

PVP-OPM

This content protection method is to be implemented in the new Hi-def DVDs to prevent pirates from attaching recording devices directly to the PC graphics card's DVI or HDMI video outputs to gain access to a fully resolved unprotected image of the content. Please review the detail of this subject on the HD Content Protection Section.

Gaming

Microsoft announced at CES 2006 that they would release an external drive to allow the Xbox 360 game console to been able to play HD DVD discs and shortly after they commented that they could even do the same for a Blu-ray external drive, although that was graciously corrected later with "we have no plans for Blu-ray"….

Sony demo the PlayStation 3 console (right) at CES, and is planned for release later this year (May in US, Spring in Japan). It would play Blu-ray discs at 1080/60p and 1080i over HDMI. With High Quality Image Processing driven by RSX Graphic Processor, 32bit floating point processing for color video and audio. At the CES booth it was revealed that Sony is releasing that unit at a loss (approximately $400) to set their Blu-ray feet into the market, which also means that many BD player consumers could be benefited if buying the PS3 instead of the $1000 standalone player (if released at that price), both players are said by Sony to have the same performance and outputs. The unit on the floor showed to have 2 HDMI, 4 USBs, audio digital out, 3 RJ-45, A/V multi out. The console was claimed to also play live television when connected to a TV using Wi-Fi Internet streaming.

Format Specifications

In January, 2006, the BD Association approved the Blu-ray disc specifications as complete, and declared that licensing was ready to begin for the read-only BD-ROM, recordable BD-R, and rewritable BD-RW version 2.0 disc formats. This applies to 25GB and 50GB dual layer as well (but not the 100GB 4-layer by TDK). With this approval content providers and disc manufacturers can start producing Blu-ray disc products. According to the announcement, as of January, the application layer part was still in the works but close to completion, and still ahead is the joining of those two with the AACS part.

Computing

Microsoft announced at CES 2006 that they will support HD DVD on their near future Vista operating system. Microsoft, Intel, and NEC are backing the HD DVD format.

Toshiba also announced March's availability of the Qosmio notebook with new Centrino Duo processor with a HD DVD drive, CD/DVD multi-format read/write capabilities, $3,000 price range, 1080p screen, and HDMI output.

As mentioned before, HP has decided now to support both formats.

Pioneer unveiled their first Blu-ray disc computer drive, the BDR-101A, with 25GB of storage, TTM 1Q06, $1000, plays BD-ROM discs, and plays/records standard DVD, would offer HDTV recording capabilities with a PC HDTV tuner, as well as having 2x speed at Blu-ray, and 8x at DVD+-R, and 4x at rewritable DVD-+ formats. It can also support the reading of BD-ROM/R/RE, and all the other DVD -+ ROM/R/RW formats.

BenQ demonstrated in June 05 at Computex 2005 a Blu-ray DVD burner expected to become available in the 1-2Q06; the model BW1000 can write at 2x for Blu-ray single and dual layer, 12x for DVD+R/-R, 4x for DVD+R/-R dual layer, and 4x for DVD+RW/-RW. It reads at 2x for Blu-ray, 12x for DVD and 32x for CD.

Dell already supported Blu-ray, and Apple Computer has decided to join the Blu-ray group as well.

Toshiba HD DVD slim drive (below)

NEC HD DVD-ROM Drive HD-1100A (below)

Sony announced an external computer drive that will play and record BD discs, expected by year-end.

PC applications for BD

Nero
Sonic
New Tech Infosystems
Intervideo

Discs

Although both formats have done development efforts to provide multiple layer and hybrid solutions of 15GB, 30GB and 45GB from HD DVD, and 25/50/100 from Blu-ray, it has been announced that HD-DVD will become available in 15GB and 30GB versions and hybrid discs (HD and DVD versions of same movie), and Blu-ray will initially be released in the 25GB version and hybrid discs, the 50GB dual-layer version will arrive later.

Toshiba 38.5 GB hybrid disc is dual sided, 30 GB HD dual layer (15GB each layer) in one side for blue laser HD DVD, 8.5 GB on the other side for dual layer DVD version (4.7 GB each layer) readable with red laser.

The announced HD DVD 45 GB is a triple layer single sided blue laser-disc. The current 15 GB and 30 GB are also single sided; the 30 GB is dual layer.

Please refer to the Hi-def DVD Background section above to check the details of the disc development efforts made by both formats.

memory-tech HD DVD PRODUCTION LINE

memory-tech HD DVD MOLDING MACHINE

TDK announced in June that they have developed a 4-layer Blu-ray disc that is capable to store up to 100 GB, sufficient for holding four HD movies, and the company demo the prototype at CES. The disc records at 72 Mbps, double the 36MBps of Blu-ray, has special recording materials, and was able to perform at 6x speeds (216 Mbps) with prototype discs. TDK also developed DURABIS, a hard coating technology to protect the Blu-ray disc surface of scratches and fingerprints, to a level equivalent to 100 times better than an unprotected disc.

TDK discs will be available as 25GB BD-R (single-layer write-once), 25GB BD-RE (single layer, rewritable), 50GB BD-R (double layer, write-once), and 50GB BD-RE (double layer, rewritable), TTM was not disclosed, but more information below.

Sony BD discs for recording featuring AccuCORE scratch-guard protection, will be released in summer starting with single layer R and RE, dual layer 50GB will follow. Regarding BD-ROM movies, Sony is releasing 20 titles for the player's launch.

Sony announced in February 2006 that their new films in Blu-ray would be priced at $23.45 and catalog films at $17.95. Sony's DADC (Digital Audio Disc Corporation) replication company will begin producing Blu-laser 25 GB discs globally late February 2006 at a rate of 10 million per month with 30 replication lines. By the end of summer 2006 the plants would be ready for the 50 GB disc as well.

BD discs

TDK
Verbatim/MKM
Sony DADC
Panasonic disc manufacturing in Torrance, CA has modified (Dec 05) its existing pilot line for single-layer

BD-ROM discs to be able to replicate dual-layer discs with 50 GB of storage capacity

Recording media for HD DVD and Blu-ray

Fujifilm
Verbatim
Advanced Media
Panasonic announced US introduction of BD discs for 2006 in 25GB and 50GB storage capacity, as follows:

Model Number	Specification	SRP*
LM-BE50DE	Rewritable, 50GB, Single-Sided, Dual Layer	$59.99
LM-BE25DE	Rewritable, 25GB, Single-Sided, Single Layer	$24.99
LM-BR50DE	Write once, 50GB, Single-Sided, Dual Layer	$42.99
LM-BR25DE	Write once, 25GB, Single-Sided, Single Layer	$17.99

(data above courtesy of Panasonic)

BD-ROM Pre-recorded Media

Studio Announcements

In July 2005, Fox announced that, due to the BD+ protection Blu-ray incorporated in their format, the company has decided to support Blu-ray for home video releases in HD.

In August 2005, Universal Music Group (UMG), one of world's largest music companies, joined the Blu-ray Disc Association (BDA) as a contributing member (more than 140 leading members). Content from Universal Music includes Elton John, Maria Carey, and U2.

In August 2005, Lions Gate Entertainment (LGHE), a division of Lions Gate Entertainment announced that it would release content on the Blu-ray Disc format. The studio is the fourth major studio to commit publishing movies in Blu-ray, and represents 4% of the home video market.

In October 2005, Warner announced that the studio would release titles also in the Blu-ray format in the US, Europe, and Japan; Warner also announced that it joined the BD Association.

In November 2005, MGM was reported to support the Blu-ray format. It will begin releasing titles from its library of 4000 films.

Launching Announcements

Both formats brought to CES a collection of movies that would be released upon their individual launches, including some classics and many blockbusters. Many studios are expected to release movies on both formats.

HD DVD launch

The format launch in March would be accompanied by gradual release of titles from:

Warner Home Video,
Paramount Pictures,
Universal Studios,
HBO Video,
New Line Entertainment, and recently the following two
Europe's Studio Canal and the Weinstein Company (Miramax previous owners), and
Customflix.com (Amazon owned) for independent and small filmmakers.

According to Access Hollywood, these companies represent more than half of produced movies. Upon launch, there will be only a few titles released such as Twister, Lethal Weapon, U-571, and Apollo13, but by June, about 50 titles would be available, to total 200 titles by December's Holidays. The titles will become available in a mixture of HD-DVD discs and hybrid discs that contain also the DVD version of the content, which were said to cost a few dollars more.

Blu-ray launch

The launch in April will be accompanied by the gradual release of about 100 titles during 2006 from six studios as follows:

Paramount Pictures:
"Four Brothers," "Sahara," "Aeon Flux," "Sky Captain & the World of Tomorrow," "The Italian Job," "Tomb Raider," "U2: Rattle and Hum," "Sleepy Hollow," "We Were Soldiers," "Manchurian Candidate," "Mission Impossible," "Mission Impossible 2," "Mission Impossible 3";

Warner Home Video:
"Batman Begins," "Charlie & The Chocolate Factory," "Constantine," "The Dukes of Hazzard," "The Last Samurai," "Lethal Weapon," "The Matrix," "Million Dollar Baby," "Oceans 12," "Swordfish," "Terminator 3: Rise of the Machines," "Training Day," "Troy," "Twister," and "Unforgiven"

Twentieth Century Fox Home Entertainment:
20 Titles, including: "Fantastic Four," "The League of Extraordinary Gentlemen," "Behind Enemy Lines," "Kiss of the Dragon" and "Ice Age";

Sony Pictures Home Entertainment/MGM/Columbia Pictures:
"The Fifth Element," "Bram Stoker's Dracula," "Desperado," "For a Few Dollars More," "The Guns of Navarone," "Hitch," "House of Flying Daggers," "A Knight's Tale," "Kung Fu Hustle," "The Last Waltz," "Legends of the Fall," "Resident Evil Apocalypse," "Robocop," "Sense and Sensibility," "Stealth," "Species," "SWAT," "XXX," "Black Hawk Down" and "The Bridge on the River Kwai"
Sony will release four movies x month, increasing to 10 x month by the end of 2006.

Lion's Gate Home Entertainment:
"Lord of War," "The Punisher," "Devil's Rejects," "Saw," "T2: Judgment Day," "Reservoir Dogs," "Total Recall," "Dune," "Rambo: First Blood" and "See No Evil"

Buena Vista Home Entertainment/Disney:

"Kill Bill: Vol. 1," "Hero," "Dark Water," "Ladder 49," "The Brothers Grimm," "The Great Raid," "Armageddon," "Jay and Silent Bob Strike Back," "Dinosaur" & "Everest"
Eagle Rock Entertainment:
Will provide 20 music artists such as Miles Davies and George Benson.

HD DVD Equipment

LG
Announced and showed the HD-199 HD DVD player (and a Blu-ray player as well), however, in March 2006 LG announced that the unit will not be released as planned. See their Blu-ray player further below for details.

Toshiba
The company announced two HD DVD players to be released by March, one low-end unit for $500 (HD-A1), and another hi-end model for $800 (HD-XA1, right). Blu-ray commented that the pricing of these Toshiba players was half of what was originally intended to attract the mass market.

HD-XA1 player:
Two USB ports in front panel, HDMI 1.1 with audio support up to 5.1 L-PCM, 1 component, Toslink, coax digital out, 5.1 multi-channel analog audio gold plated, Ethernet 10/100 Port, RS-232, Dolby Digital, Dolby Digital Plus, DTS and DTS-HD decoders, Dolby TrueHD (2 channel), outputs Dolby Digital Plus and DTS-HD streams over HDMI for external decoding (with HDMI 1.1?), or output as PCM decoded internally, four 32-bit floating point digital signal processors.

Multi-channel 24-bit/192hHz audio DACs, 5.1channel bass management (speaker size, speaker distance, user selectable crossover of 80Hz/100Hz/120Hz, channel level adjustment), dynamic range control, MP3 and WMA playback, supports 720p and 1080i formats, does not output 1080p over HDMI, neither supports 1080i over component analog outputs, 11-bit / 216MHz video DAC, video upconversion for SD DVD to 720p/1080i, enhanced black level (0IRE / 7.5IRE selection), letterbox / Pan Scan selection, disc playback of HD DVD, HD DVD-R, DVD, DVD-R/-RW/-RAM, CD, CR-R/-RW.

Crutchfield, Sears, Best Buy, Amazon, and Tweeter have taken distribution of the players. The differences of the HD-AX1 player with the lower priced brother (unit HD-A1 on left) are: two front USB connections for gaming controllers, 3 different user selectable interfaces, RS-232 output, insulated stabilizing feet, motorized door that conceals the disc drawer, function buttons, and backlit remote control that is motion activated. Other than those, they were said to have the same connectivity and performance level.

Thomson / RCA
The company announced the 2Q06 availability of their HDV500 $500 HD DVD player, which was quoted as able to transfer HD video up to 1080p via HDMI 1.3 output (right).

Sanyo
The company unveiled their HD DVD player model HD-S100, TTM March 06, outputs 1080i/720p/480i/p, 1080i on the first generation, $500.

Blu-ray Equipment

Hitachi
HDD and Blu-ray combo recorder (right):
The company announced the world's first 1-Terabit HDD and dual digital recorder capable of recording two simultaneous HD broadcasts, with a capacity of 128hrs of digital recording or 1700 hours in extended play mode. The recorder supports also the Blu-ray/DVD/CD formats, able to store up to 2 hours of HD in a Blu-ray disc. Hitachi showed a BD player, TTM end 2006.

JVC
JVC demo their BD player (left), no plans to support the other HD DVD format, no date commitment for their BD player.
The company announced the development of the world's first Blu-ray/DVD Hybrid ROM disc using three layers to store both HD and SD content on a single side, a technique authorized as part of the

Blu-ray disc format by the Blu-ray Association. Pre-recorded three layer hybrid discs will be available upon BD introduction.

LG

The company introduced their Blu-ray player model BD199 (left), TTM 2Q06 release date was already announced even though final ROM specs were not yet completed when announced.

Plays back 1080p from a 1080p content in disc, and 1080i50/60fps, DTS++. However, in March 2006 LG announced that the player will not be released, and instead the company is planning to develop and release a dual-format player in late summer/early fall "in light of the uncertainty in this early stage of the market for pre-recorded high-definition optical discs", LG's VP Bob Perry said.

Mitsubishi

The company showed the 1080p Blu-ray prototype model below, TTM N/A, $ N/A.

Panasonic

The company announced their launch of their 1080p Blu-ray player DMR-E700BD in summer 2006 (below).

Philips

The company plans to release first in the US in the 2H06 a Blu-ray player and a PC triple-writer (for Blu-ray write-once and rewritable discs, as well as DVDs and CDs writing).

As with past years at CES, Philips just demonstrated prototypes and pricing was not confirmed. Supports DTS-HD and Dolby TrueHD via HDMI 1.3, which would support 1080p, although it was not confirmed if the player would be released with such output capability. Multi-channel analog outputs not confirmed to be suited to carry the newer hi-bit DTS and Dolby codecs.

As with the Pioneer BD player (further below), the unit was said not to have Internet audio streaming support on its first generation for Director's commentary while the disc is playing.

Philips CEO, Rudy Provoost, made a remark of importance to about 10 million early adopters of HDTV with only analog inputs on their sets: " The company said it's confident the AACS content-protection group would approve copy-protection rules that would allow component analog outputs to carry HD video to early-generation HDTV monitors and TVs that lack HDMI inputs." Unfortunately, after the remark was made, the AACS organization did not approve the feature that way, please check the Content Protection section for details.

Philips plans to introduce a Blu-ray player/recorder in 1H07 that also would play/record CDs and DVDs.

Pioneer

Pioneer's Blu-ray BDP-HD1 player is due in May (also quoted as available earlier in April), MSRP of $1,800 under the Elite brand, Pioneer booth reps commented there might be another non-Elite player later, the high price is consistent to other Elite products were higher quality is expected (below at right).

The player has HDMI output (quoted to be as 1.3 spec upon releasing the player) to transfer 1,080p video to 1,080p displays, and is reported to also include IEEE-1394 (iLink) with DTCP.

One such display is the 1080p plasma that Pioneer also introduced at CES, the Elite PRO-FHD1 for $10,000 MSRP, TTM June 06, with HDMI, DVI, and component inputs.

No confirmation was given about HD content over analog outputs on the Blu-ray player, however, after CES, the AACS group decided to downres HD content to 960x540p over component analog connections, when/if the disc instructs the player to do so.

The player can output 1080i but it can output 1080p at 24 fps as well, according with Pioneer, which would fit well with their Elite plasmas that perform 3:3 up framing to display the image as 72 Hz, or with other display devices that accept 24fps, such as some front projectors.

The player supports audio codes such as WMA, MP3, LPCM, but does not support the Dolby Digital Plus nor Dolby TrueHD hi-bit codecs due to some timing problem in the availability of chips for Pioneer's schedule. It supports the rest of the other audio codecs, including Dolby Digital and the hi-bit DTS-HD codec, which are outputted thru HDMI 1.3 jack.

No confirmation was given about supporting DVD-A and SACD multichannel audio, but it is assumed that the player would support them with its analog connectors, especially at the $1800 price level, DLNA (Digital Living Network Alliance) compliant for IP-based networking of audio/video streams, although Internet audio-streamed content was part of the plans, the first generation player would not have such feature.

The BDP-HD1 supports video playback of Blu-ray Disc BD-RE, BD-R, BD-ROM, JPEG image files, DVD-R/-RW, DVD-RAM, DVD+R/RW discs, and WMV, DiVX, DiVX-HD and MPEG-2 video formats.

Samsung

The company announced their BD-P1000 player to be released on April 06, $1000 MSRP (but also quoted as $1200), outputs 1080i and 720p in addition to SD, in theory the player would be the first Blu-ray player to hit the market after its HD DVD competitor format does in March. It was verbally indicated that the unit would not output 1080p and there was not any written information to confirm the contrary.

The player specifications include component output, HDMI, and both digital and analog audio outputs, audio formats include 192KHz LPCM, Dolby digital, Dolby Digital Plus, Dolby TrueHD, DTS-HD, MPEG 2, DTS and MP3, a memory card reader supporting Compact Flash, XD Picture card, Micro Drive, SD, MMC & RS-MMC, Memory stick and Memory stick duo.

Although it was earlier commented that Samsung would also produce a player that would support the HD-DVD format, it was negated at this time.

Samsung also demo a Blu-ray recorder (BD-HR1000) that is also a network center with Ethernet IEEE802.11b/g wired/wireless transmission of audio/video (DVD quality) with PC, the unit records also in its internal 400GB HDD DVR (47hrs HD), 2.5 hrs HD recording on Blu-ray disc, available in Korea for $5,000 (right), HDMI out (720p/1080i) EPG.

Sharp
The company demo their DV-BP1U Blu-ray player (below with specs), 1080i/720p HDMI outputs, Dolby TrueHD, DTS HD.

Sony
Sony demonstrated and announced availability for sprint 2006 a series of Blu-ray products from a stand-alone player (BDP-S1), VAIO desktop computers with BD drives, and separate drives for BD playing and recording (BD-R write-once and BD-RE rewritable).

The BDP-S1 (right) will TTM in summer 2006 and will output 1080p 60fps over HDMI although it was indicated that the output resolution would automatically adjust to the native resolution of the display (Sony did not confirm if there is an option to override the automatic setting of the output resolution by a user menu for the optional use of 1080p scalers between the player and the HDTV).

The player also outputs 1080i, however, the AACS decided later (after CES) about the component analog 1080i subject, see the AACS content protection update section. The player also does upscaling to other resolutions (60i/50i/24p) to match the display resolution/frame rate, NO IEEE1394, $ was not officially announced but rumored to be in the $1,000 range, although HD DVD pricing and PS3 could bring that price down to be competitive.

The player decodes MPEG-2, MPEG-4 AVC, VC-1, at a max bit rate of 40 Mbps, handles up to 32 separate audio streams, up to 8 channels, DD Plus (max 4.736 Mbps, 7.1 channels), Dolby True HD (max 18.64 Mbps, 8 channels), DTS-HD (max 24.5 Mbps, 8 channels). Demos were made with the player as 1080i output to their current XBR RPTV (that does not accept 1080p), letting the TV set to deinterlace the 1080i to a 1080p image.

Analysis

There are several factors that might affect the adoption and success of any format at product introduction, is complicated, but they all have to merge well enough to strike the correct balance of cost, protection of content, protection of the consumer rights, backward compatibility with existing HDTVs delivering the full quality of the format, be future proof for 1080p HDTVs accepting 1080p, etc. to mention a few.

The choice for a consumer gets more complicated when the two formats collide against each other for market domination with showing similar features, quality, and strong studio support, but there is no apparent logical explanation of why one format is releasing players at almost half price of the other. Let us look at it:

Choosing the Player

A consumer that does not have a 1080p HDTV (or one that has it but does not accept 1080p) might not be interested in the Blu-ray players that claim 1080p output capability (Sony, Pioneer, LG, possibly Philips, even Sony's PS3). It is obvious Blue-ray has chosen to emphasize the fact they have that feature, while HD DVD ignores it. In other words, if you were just looking for 1080i quality, spending twice as much on Blu-ray to get "similar" HD 1080i quality than HD DVD from the same movies would not seem a good investment.

On the other hand, those consumers that do have 1080p inputs might find that paying less for a non-1080p HD DVD Toshiba $500 player could become a loss of the investment down the road if/when upgrading to a 1080p display with 1080p inputs. Why? The purchased non-1080p player could turn out to be another piece to upgrade down the line once viewing what 1080p content looks like in a 1080p set.

Note that the RCA HD DVD player was the only player of the HD DVD format that claimed a 1080p output, while Toshiba, the leader of the format, does not offer it, the RCA spec could have been a typo; $500 and 1080p could be a good opportunity if all the other technical features are acceptable, we will know soon. Samsung gave up on a dual player but LG announced they plan to develop one for 3Q06, maybe that solves the selection problem, if the price is right.

Players on both formats claimed different capabilities regarding optional multi-channel audio codecs, some do DTS-HD but no Dolby TrueHD, some do Dolby TrueHD but only as two channel, some have an encoder to mix the additional audio (director, etc) over the soundtrack channels into the HDMI connection, some do not.

Check the Multichannel Audio for HD section to find about the connectivity issues for playing the new audio codecs on Hi-def DVD players.

Cutting out Early Adopters, Possible Consequences

Ironically, although the large mass of HDTV early adopters (about 10 million) would be the most appropriate to start up another high quality format like Hi-def DVD, they are actually out of luck with the recent AACS decision of not allowing HD over the player's analog connection, which is the only connection their TVs have for HD.

This also affects a large number of movie viewers that use their PC as a home-theater with a new Hi-def DVD player drive (either format), and the PC/monitor system is not suited with an HDCP content protection connection, very common not to have it for most computer purposes.

If the content provider of a movie sets the AACS Image Constraint token (ICT) the HD player will down-res the analog output. That will certainly be a turn-off for adopting either format by all those millions of legacy HDTV and PC owners.

However, when a studio uses the ICT token the disc package must indicate so. Buyers could chose not to buy the disc; if many movies of a format are found token protected, it could also affect the sales of players of that format (or both formats) from all those million of early adopters, which has the potential to produce apathy in making a purchase, those millions of HDTV early adopters might rather wait a few months to see how the token is being used by which studios, which format, and for which type of movies (blockbusters, collection, etc).

It would be illogical that studios producing discs on both formats would issue a movie with token in one format but not in the other. Both formats could be affected equally with the token issue, but anything could happen in the heat of a format war.

If the launching would be for just one format, a slower momentum to reach market acceptance might not hurt as much as when two formats are competing with each other. They are both under the pressure of demonstrating success as quickly as possible to the shareholders that want to see ROI after so much "I". Time is very valuable in those circumstances, cutting out the very people that could almost guarantee the sale of 10 million units might be very damaging, to everyone.

An over protecting token idea could become the worst enemy of the needed success because it makes the adoption slower, neither side would want to withdraw but eventually one might have to, prolonging the withdrawal decision could produce economic loses much larger than dropping the ball in time and move on to another CE business.

Early adopters invested top dollars on expensive early generation HDTVs since 1998, those dollars helped build the R&D for manufacturers to be successful with HDTV. The HDTV industry owes those early adopters, should thank them, and give them the right to view a HD movie in HD regardless of the connection they use, a movie they paid for on a display they paid for.

<u>1080p and Hi-def DVD</u>

From another perspective, the most recent group of owners and prospective buyers of 1080p HDTVs is being affected by the confusion created by misleading statements from manufacturers, the AACS, the DVD Forum, the BD Association, and the MPAA regarding the true reason for certain players not having 1080p outputs, and some 1080p HDTVs not having 1080p inputs, while others do. How difficult is to admit: "we designed it that way to cut costs and because we thought 1080p would not be attractive to our customers", rather than pointing fingers and say "is the HDMI spec, the chip manufacturer, the content protection spec, the format, etc."

Many 1080p manufacturers are still blaming HDMI specifications and chips, when is their equipment design or choice of HDMI chip receiver (and most probably both) the reason for not been able to handle 1080p. That affects Hi-def DVD as well as 1080p TV sales.

We already passed the stage of 1080i/720p in many fronts, Hi-def DVD 1080p content will arrive this month, 1080p video processors have being around for a while already, 1080p displays are moving into a second generation, DVI and HDMI specs supported 1080p since day one (*), some 1080p HDMI chips are even cheaper than non-1080p chips (*), there is not need for broadcast/satellite/cable to be 1080p for the above to work, therefore, why limit the vision by not letting those 1080p pieces perform and connect well as 1080p? *(*) source: Silicon Image*

Sony and Pioneer have already announced and demo 1080p outputs on their players, while Toshiba is not providing those outputs. It is unclear how the AACS and both format standard organizations play a role in a manufacturer's decision of providing or not such feature.

A Different View of Hi-def DVD Booths at CES

Is 6:00 PM!

Quickly, lock away these Hi-def DVD players from the pirates, I meant consumers; they would even copy our fake carton mockups to install in their Home Theaters!

Taiwan's Forward Versatile Disc (FVD)

Over the past couple of years, I have written on these reports (as well as in the pages of DVDetc and HDTVetc Magazines) about the four Hi-def DVD formats in the China/Taiwan market, three from China (EVD, HVD, and HDV), and one from Taiwan (FVD).

On this opportunity, I met at CES 2006 with Mr. Job Liu, Managing Director of POSO (Power Source Group Limited), who was representing the FVD format at CES. Mr. Liu introduced also Margaret Fan, General Manager of Idar Electronics Co., a company involved with the FVD players and format.

They showed the player, the movies, the FVD format efforts, and we discussed about specifications and technical capabilities of the format, discs, and players. At the end of our long meeting, I was offered if I wanted to take the player with me after the show, I took me by surprise, I declined politely, but I certainly accepted an FVD disc demo as my after show teaser.

FVD discs and players are already available for sale. The player MSRP is $250, and FVD movies were quoted as about $6 per disc, although I have not seen an official price list as I did with Chinese EVD companies the year before.

FVD is a red laser solution that supports FVD-video and WMV-9 HD video codecs, and WMA, LPCM and ITRI-Audio codecs. The disc can store 135 minutes of HD full-length movies in 720p/24/30 (SL), or in 1080i60/p24 (DL, or 3 hrs TL), in addition to 720x480 and 320x240 regular video resolution at 60i.

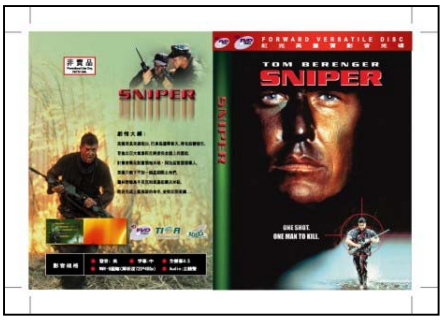
The FVD player is suited with DVI/HDMI and component analog connections, optical and coax for 5.1 or 2-channel audio, peak bit rate 15Mbps. According to the company at CES the player is able to output 1080i over component analog because the format uses its own content protection system (ITRI-AES, Innovative Technologies Research Institute - Advanced Encryption Standard).

There is a PC playback software version (Super FVD, in beta now) that allows the use of existing DVD-ROM drives for HD FVD playback of movies without any additional hardware. There is no need for Microsoft's Media Center in the PC because as mentioned above the format uses its own content protection system, no DRM.

There are 29 companies and ITRI in the AOSRA (Taiwan Advanced Optical Storage Research Alliance), an organization founded in January 2002.

There are Several FVD disc producers like RiTek Corporation, Prodisc Technology Inc., U-Tech Media Corporation, Leaddata, Infodisc, Giga Storage, Optodisc, Nan-Ya, and

CMC Magnetics Co. (their discs are pictured above on the left). Players are being manufactured by TATUNG, BenQ, LITE-ON, Actima, Mustek, PROTOP, Arima, MSI, QSINC, Ultima, and A-DATA. Chip-set manufacturers include VOS, ALI, MTK, SUNPLUS, and CHEERTEK. Video software content includes Newsoft, Deltamac, and Cine-Asia Entertainment.



In addition to the existing titles, and WM9, fourteen FVD films were planned to be released soon: Air Panic, Avalanche, City of Fear, Death Train, Edges of the Lord, The Order, Us Seals, The Confession, Earthquake, Fire, Volcano, A Wobot Christmas, The Opponent, Diary of a City Priest, Buried Lies, Combustion, Malie.

Idar Electronics Co. below

FVD was introduced on April 5, 2004 in Taipei Taiwan. The first FVD players were made available in May 2005 for $175 with 10 free movies in Taiwan.

With a sales promotion in Europe and the US, the global volume was estimated to reach 100,000 players in 2005, 3 million in 2006, and 5 million in 2007. Later, Taiwan's Kolin offered in November 2005 an initial sales promotion period for their first KVD-1080 player with an HDMI cable included, and three 1080i FVD movie discs, all for $240.

Content is available mainly from independent studios but the alliance is doing efforts to expand to 100 the initial offering of titles by including other major studios.

Comparison of Formats				
	DVD	**FVD**	**HD DVD**	**BD**
Leading Organization	DVD Forum	Taiwan's AOSRA	DVD Forum	Blu-ray Association
Physical Capacity (single side)	(SL) 4.7GB (DL) 8.5GB	(SL) 5.4/6GB (DL) 9.8/11GB (TL) 15GB	(SL) 15GB (DL) 30GB (TL) 45GB	(SL) 25GB (DL) 50GB (4L) 100GB(TDK)
Laser	Red Laser (650nm)	Red Laser (650nm)	Blue Laser (405nm)	Blue Laser (405nm)
Resolution	720x480i60	1280x720p24 1920x1080i60 1920x1080p24	1280x720p 1920x1080i/p	1280x720p 1920x1080i60 1920x1080p24

Chart sourced from FDV with my additions/corrections

HD Signal Processors

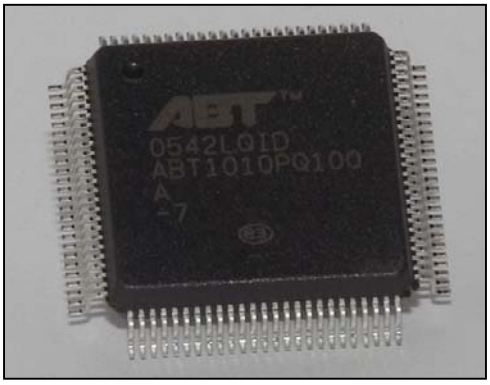
A good number of processors were included on earlier State of H/DTV Review reports. Many of those units are still available as current models from companies like Lumagen, Center Stage, Cinemateq, Faroudja, Key Digital, etc. Please consult those documents for details on the products.

I am listing first some companies that have created video processing solutions, such as ABT, creator of the DVDO product, the Realta HQV by Silicon Optix, and the VXP by Gennum. Following that group, I review products/companies that have implemented the above video processing (or their own) on their scalers.

Video Processing Engines

ABT

Anchor Bay Technologies is the original creator of the award winning line of DVDO® iScan, the company demonstrated at CES a 1080i deinterlacer among other technologies. ABT's HD de-interlacing technology includes detection of interlaced video, which originated from any progressive source, motion, and edge-adaptive de-interlacing for video sources as well as low latency options for video gaming. ABT's Precision Video Scaling technology was first deployed in ABT's DVDO iScan HD. It has recently been designed into Marantz's DV9600 DVD player as well as Denon's flagship DVD player, the DVD-5910. The scaling engine is completely flexible, accepting standard definition (480p, 576p) and high definition (720p and 1080i) inputs and outputting any resolution from VGA (640x480) to 1080p (1920x1080) with multiple standard and custom aspect ratios. Since the scaling engine is completely flexible, other image manipulation features are also supported including zoom, pan and border controls. ABT's high performance frame rate conversion also supports converting film sources from 24 frames per second to 48, 60 or 72 frames per second.



Gennum Corporation

Gennum Corporation is a leading producer of hybrid and silicon integrated circuits (ICs), electrical components and sub-systems for the video and audio markets, and a new provider to the data communications market.

The following statements were mentioned about this company's new video processors GF9350 and GF9351, both suited with VXP Visual Excellence Processing technology, originally designed for broadcast quality use. These products are being implemented by companies like Christie, Leitch, Anthem, LG, Samsung, Optoma, Marantz, and Pixel Magic, a couple of examples are: high quality video processors, like Pixel Works' Crystalio II, and the not yet available Optoma's front projector model 81, true single-chip 1920x1080p DLP projector slated for later 2006 (of which a witness the excellent demo at CES):

“The VXP technology incorporates fourth generation broadcast quality image processing algorithms, which deliver superior SD and HD video image quality. The key features of VXP technology include:

- 1080p adaptive de-interlacing for optimal image sharpness TruMotionHD™ 1080i and resolution.
- FineEdge™ dynamic directional interpolation to eliminate jaggy artifacts found in traditional de-interlacing algorithms.
- FidelityEngine™ image enhancements for removal of unwanted noise and improved detail and uncompromised image quality.
- RealityExpansion™10-bit image processing for eye-catching natural imagery.”

VXP supports picture-in-picture (PIP), picture-on-picture (POP), and picture-by-picture (PBP) applications, and supports all VESA and SMPTE formats up to 2048 lines by 2048 samples, universal frame rate conversion and full programmability for dynamic effects.

Fidelity Engine Processing

TruMotionHD Processing

FineEdge Processing

Silicon Optix

This company was covered on the CES 2005 report when they introduced their Realta HQV video-processing engine; please refer to that document for details.

Other companies implementing their video processing-engine have quoted impressive performance statements about the Realta product; some of those are as follows:

"The Realta HQV processor powered by Teranex with true 10-bit video processing, full four-field motion adaptive video de-interlacing for both standard definition and high definition signals, temporal-recursive noise reduction, automatic multi-cadence detection, and pixel-based detail enhancement. It also utilizes the same video processing power—1 trillion operations per second—as the famous $60k Teranex Xantus box."

"Instead of discarding half the resolution, and just doubling the lines (a shortcut that many video processors take today). HQV processes all 2 million+ pixels in both odd and even fields of a 1080i signal preserving all the rich details in an HD scene. Also, HQV per-pixel, motion adaptive noise reduction cleans the random noise that can plague HD broadcasts."

"Currently, given the scarcity of HD content, most of the HD broadcast programs are SD material up-converted to HD, often with Teranex equipment. Also, for years to come, much of the TV programming will continue to be delivered as standard-definition (SD) 480-line interlaced video. Going from 480i video to 1080p involves resizing an image up to six times."

"Realta HQV employs for 480i to 1080p conversion the same algorithms used in Teranex up-conversion equipment. The processing relies on a combination of powerful features, such as multiple fields pixel-by-pixel analysis, 1024-tap scaler, HQV detail enhancement, HQV random, block and mosquito noise reduction, to deliver standard-definition broadcast TV and DVDs that approach HD quality."

"Unlike any other video processor, Realta HQV is also fully software programmable and upgradeable. The Realta HQV processor executes its video algorithms entirely in software. As new video processing software is developed, consumers can simply download the upgrades."

"The Realta HQV video engine has received numerous awards and accolades, including the "Best of Innovations" award for the Embedded Technologies category at the 2005 Consumer Electronics Show, "Most Promising New Technology" and "Most Exciting New Company" from The Perfect Vision, "Best Buzz of CEDIA" from Insight Media, AVGuide Monthly's "Best Product Overall," Red Herring's "Top 100 Innovators" award, Fred Kahn's "Silver Best of CES" award, and most recently "Best Picture of the Show" at the Home Entertainment 2005 Show in New York City, from Tom Norton of UltimateAVmag.com."

Additionally, the company has introduced a test program for video products, the "HQV Benchmark Test DVD" for consumers to objectively evaluate picture quality. The test program includes patterns that have been designed to evaluate video

performance such as decoding, video deinterlacing, film-cadence detection, video-over film, motion correction, noise reduction, and detail enhancement, in addition to ten tests with color bars, jaggies patterns, waving flag, detailed static image, etc. MSRP $30, TTM now.

Processors Using HD Video Processing Engines

Algolith

DragonFly video processor, $3,000, details and specs on CES 2005 report. According to the conversations I had at CES, the company had some financial problems that made it unable to release the product as originally planned by mid-2005, and is now planned for release in 1Q06. The unit implements Silicon Optix Realta HQV chip, 1 component in (max 1080i/60), 2 HDMI in (max 1080i/60), 1 component out (max 1080i/60), RGBHV (max WXGA), 1 HDMI out (max 1080i/p/60), no pass-thru of 1080p apparently because it does not even accept 1080p, full four field deinterlacing window for HD deinterlacing and cadence detection (1080i to 1080p), upgradeable algorithms via USB port. 1080p output could be 24/30/60fps.

DVDO

VP30, Third Generation 1080p capable video processor, ABT's Precision Video Scaling II technology with 10-bit scaling, enhanced sharpness controls and non-liner scaling, analog transcoding, 11 video inputs (4 HDMI, 2 component, RGBHV, optional SD-SDI input), each input has separate picture controls, $2,000, TTM now.

Other DVDO models are listed on the CES 2005 report.

Calibre

In September 2005, the company launched their Vantage-HD Home Theater video scaler and switcher suited with Silicon Optix Realta HQV chip with true 10-bit processing, automatic multi cadence detection, and four-field per pixel deinterlacing, $2,900, TTM 4Q05.

Upon the introduction of the Vantage product the company released the following statements:

"The video processing built into most home theater displays and progressive-scan DVD players has limited processing ability and runs basic algorithms none of which

can match the awesome power of Vantage-HD's 1T-flop DSP with 30-bit 4:4:4 scaler datapath, 12-bit component video A/Ds and studio quality 10-bit video decoder with super-adaptive comb filter and 4 x ITU656 over sampling."

"Vantage-HD includes per pixel multi-angle aperture-adjusted motion-compensated de-interlacing of both SD and HD images, with full de-interlace performance on 1080i formats as well as 480i and 576i, out performing all competitor algorithms providing a level of de-interlacing quality previously only found in high end studio facilities."

"Vantage-HD expertly processes film based material with full automatic detection of all pull-down cadences including broken cadences and non-standard cadences typically found in animation sequences, as well as the common 3:2 and 2:2 formats, all with automatic scene change detection to ensure clean cuts between scenes and the ability to process mixed scenes where film and video are overlaid."

"Lip-Sync errors significantly degrade the home theater viewing experience Vantage-HD automatically adjusts the audio time-line to suit its internal video processing delay. Audio time-line correction operates on all audio channels—digital coaxial, digital fiber-optic, analog and HDMI audio channels. It's easy to see that Vantage-HD is far more than just another scaler."

"For DVD and digital cable/satellite users Vantage-HD provides real-time MPEG artifact reduction while leaving picture detail intact. Even conventional external scalers don't fix all picture defects, even those considered benchmarks in home theater cannot reduce MPEG noise and cannot run their full de-interlace algorithms on HD signals due to a lack of real-time processing power."

Digital Projection

In September 2005, the company released a new video processor developed in partnership with Silicon Optix for use with Digital Projection displays. The VIP 1000 is suited with the Silicon Optix Realta HQV state-of-the-art processor. Details about the Realta processor were mentioned on the product above (from Calibre), which also uses the same chip. MSRP $6,000, TTM 4Q05.

Lumagen

Most Lumagen products can be found in the CES 2005 report.

In September 2005 the company declared that they now use Silicon Optix's Realta HQV engine on the new processor they were developing, RadianceXD, TTM 2Q06.

NEC

In June 2005, the company announced that was partnering with Silicon Image to implement the Realta HQV engine on their plasma panels and projectors via the new NEC Theater Sync™ external video processing unit that will seamlessly connect to its displays.

The Theater Sync unit handles all SD, HD, and PC signals over standard analog, DVI, and HDMI inputs, and will incorporate the newest HQV algorithm, CNR™ (CODEC Noise Reduction), to reduce the artifacts caused by MPEG and other CODEC compression methodologies. MSRP $3,600, TTM Oct 05.

Pixel Magic

In September 2005, the company announced their new Crystalio II HD consumer video processor implementing Gennum Corporation's VXP (Virtual Excellence Processing) engine with upconversion to 1080p60fps.

The product information supplied by the company is as follows:

" The Crystalio™ II, the second generation in the Crystalio™ product family, is an advanced video processor with true 1080p HD motion adaptive de-interlacing and true 10-bit 4:4:4 broadcast quality processing. The Crystalio™ II also includes a wide range of advanced capabilities including 4 HDMI inputs, 2 HD-SDI/SD-SDI inputs, Ultra Fine Audio Delay™, an internal HD media player, and support for 48 Hz and 72 Hz outputs."

HDTV Video Cameras

HDV Format

HDV was announced in the summer of 2003 and was established as an official format in the fall of 2003. Canon, JVC, Sharp, and Sony are the primary manufacturers supporting this HD format that uses mini-DV videotape, MPEG-2 and at resolutions of 1080i and 720p. The companies indicated that camcorders could be made that can record on the same mini-DV both regular and HD formats.

Ambarella (chip)

Dec 05
A1 digital camera SoC (System on Chip) platform, TTM now
The platform combines an HD H.264/AVC codec video processor, still image processor, audio compression, and system functions on one chip with an operating power of less than 1W and priced for consumer applications. 2.5x compression gain over MPEG-2/4 would allow storage of HD video content in flash-based memory.
For more information, visit www.ambarella.com

Canon

Sep 05
XL H1 HD camcorder, $9,000, TTM Nov 05
Records images at 1,080i resolution to DV tape using three 1/3 inch interlaced CCDs, selectable frame rates of 60i, 30 frames per second (fps) and 24 fps. HD-SDI output for image transferring, 20x optical zoom lens with built-in optical image stabilization technology, Canon's DIGIC DV II processor, captures 2-megapixel still images to an SD card.

Still picture technology in development by Canon: "Automatic face detection technology" Cameras using this technology can automatically locate a person's face and apply two other developing technologies, "smile detection" and "blink detection," that will tell the camera to wait until the subject is smiling and has his/her eyes open before snapping the picture.

JVC

Sep 05
HDD attachment for tape less HD recording
DR-HD100, $N/A, TTM N/A, 40GB (3hrs) and 80 GB HDD (7 hrs), attaches directly on the JVC GY-HD100E camcorder, FireWire to communicate audio, video, time code, and control information. Records and backs-up both DV and HDVTM video, newly developed MPEG-2 encoding chip enables high quality pictures to be recorded readily

to both hard disk and compact DV cassettes simultaneously or consecutively, records standard definition DV25 files to disk as Raw DV, AVI Type 1, AVI Type 2, AVI Type 2 24p, Matrox AVI, Canopus AVI, QuickTime or QuickTime 24p and includes MXF, Pinnacle AVI and Avid DV-OMF format support. It records high definition 720p 24/25/30 M2T for HD non-linear editing systems.

Panasonic

Oct 05
AG-DVX100B camcorder

Camera-to-camera time-code synchronization (facilitating simultaneous, multi-camera shoots). User-settable file transfer over IEEE 1394, 24p/30p/60i MiniDV, a successor to its AG-DVX100A and AG-DVX100 models, RoHS-compliant (virtually free of lead, arsenic and other hazardous substances, directive becomes mandatory July 2006 in Europe), 4lb, 16:9 letter-box display mode on the electronic viewfinder (EVF), 3.5in color LCD monitor for distortion-free Squeeze Mode or Anamorphic Display, remote control of focus and iris (wired) when mounted on a jib or tripod, single button character off for LCD and EVF displays, improved video S/N for better low light recording; and higher resolution LCD (210,000 pixels) and EVF (235,000 pixels) monitors. www.panasonic.com/dvcinema.

Panasonic Broadcast

AG-HVX200 handheld HD solid-state storage camcorder, $6,000, TTM Dec 05,

captures video in 21 video formats, recording in both 1080i and 720p at 100Mb/s DVCPRO HD, intra-frame compression, full 4:2:2 color sampling, video is recorded onto P2 cards as IT-friendly MXF files in 1080/60i, 30p and 24p; in 720/60p, 30p and 24p; in 50Mb/s DVCPRO50 and in 25Mb/s DVCPRO or DV, provides 64 minutes of record time in DVCPRO or DV using two of Panasonic's new 8GB P2 cards, 40 minutes in 720p, 32 minutes in DVCPRO50; and 16 minutes in 1080/60i and 720/60p.

P2 card video can be downloaded to a nonlinear editing system or server, or instantly edited from the P2 card through an IEEE 1394 or USB 2.0 interface. The AG-HVX200 is also equipped with a MiniDV tape drive for shooting 4:3 and 16:9 images onto DV tape in 60i, 30p and 24p. With two P2 card slots, a shooter has hot-swap capability and a loop-recording feature. To prevent missing the start of a press conference or event, the camera can be preset to pre-record (up to seven seconds in DVCPRO and three seconds in DVCPRO HD.

Captures images at any of 11 rates between 12fps and 60fps. Camera play back of the recording at normal rate allows the shooter to preview the off-speed effect without a frame rate converter. Down-converts off-speed recordings in 720p from a P2 card and copy it to a MiniDV tape to allow creation of special off-speed effects during DV production (technique previously possible only with a complete VariCam system).

Eight gamma modes including Cine-Like gamma, and for newsgathering, a news gamma curve to assist a news photographer by allowing him to suppress over-saturated highlight areas during sudden contrast changes.

Native progressive 16:9 1/3in, 3-CCD optical block, and a wide-angle, 13X Leica Dicomar HD lens with optical image stabilization. The lens covers a wide range from 4.2mm to 55mm.

In the wide-screen mode, the 3.5in LCD monitor can display images in letterbox, which places vital camera operating information in areas above and below the active image area. The LCD permits the shooter to view and select thumbnail clips to speed editing, and allows random access to the thumbnail-displayed scenes (from the P2 card) for instant playback and the creation of an in-camera storyboard.

Audio is supported with four-channel non-compressed 48KHz/16-bit digital processing in DVCPRO HD and DVCPRO50 and two channels in DVCPRO and DV. Interfaces include IEEE 1394 and USB 2.0, 2 XLR audio (with +48 volt phantom power) inputs, a component (D4) output, composite I/O, S-video I/O, audio (RCA) I/O, and headphone. Panasonic also announced that Apple's Final Cut Pro, Avid's Newscutter XP, Newscutter Adrenaline FX and Xpress HD, and Canopus Edius HD are supporting the camera with complete P2 editing solutions.

For more information on the AG-HVX200, visit www.panasonic.com/hvx200

Sanyo

Jan 06
Xacti HD1 video camera, $800, TTM Mar 06, with ultra-res an ultra-clear 2.2in OLED display with 210,000 total pixels display that flips out from the camera and rotates up to 285 degrees on axis for taking video or still images in otherwise difficult locations, pocket-sized, tape-less combo camera, weighs 8.3oz, can simultaneously record 720p HD video (MPEG-4 at 30fps) and 5.1 megapixel still images to SD flash memory card, 16:9 widescreen format (HD-SHQ / HD-HQ modes).

High-precision large-scale integration for image processing executing a vast number of calculations in a short period of time, image processing functions for HD 720p processing, real-time MPEG-4 compression and noise reduction. 10x digital

zoom, 10x optical zoom lens with a maximum aperture of f/3.5 in both wide and telephoto angles, allowing for clear images in lower light situations, 21 minutes of 720p HD on 1GB SD card, 42 minutes on a 2GB card, 2hrs in SD mode (640 x 480 pixels at 30fps progressive) on a 2GB SD card.

Sony

March 2005
HDR-HC1, TTM July 2005, $2,000 (street pricing of $1,000 on Feb 06), HDV 1080i, video and still images, Sony's CMOS imaging sensor technology (one complementary metal oxide semiconductor image sensor instead of the system of three charge-coupled devices (CCDs) employed by the HDR-FX1, one main reason for the price and size reduction from the previous model HDR-FX1), weights 1-1/2 pounds, more compact Carl Zeiss Vario-Sonnar lens.

InfoLithium battery, which delivers about 90 minutes of continuous recording (depending on recording mode), 2.7-inch wide hybrid, touch-panel LCD screen to access menu options, can switch between 16:9 and 4:3 aspect ratios (in DV mode).

Fully automatic controls, a built-in microphone for audio quality, an intelligent pop-up flash, and Super SteadyShot image stabilization. Captures 2.8-megapixel digital still images, which can be stored directly on Memory Stick PRO Duo" media for transfer to PCs and other devices.

The only HD camcorder that allows to record high-definition video and take a 1-megapixel digital still image at the same time. 10X optical and 120X digital zoom, zoom ring, zebra pattern, and spot focus. White balance, shutter speed, and focus can all be adjusted manually. Cinematic mode to record video with a film-like appearance, Shot Transition" feature to create cinematic effects, records HD in total darkness with Sony's Super NightShot Plus Infrared System.

i.Link Digital Video Interface (IEEE 1394) to enable high speed, bi-directional digital video/audio communication between two devices equipped with a compatible i.Link DV interface, including camcorders, professional digital video recorders, and PCs, PictBridge" Compatibility with PictBridge-enabled printers, such as Sony's new PictureStation" DPP-FP50.

Sony reduced the number of circuit boards from 5 to 2 and the amount of parts from 3000 to 2000 with a better design compared with the previous model. Optional accessories will include a full line of accessories, including custom cases, lights, lenses, microphones, Stamina batteries, chargers, and cables.

Sony
HDR-HC3 Jan 26, 2006. A new camcorder is expected to be announced in the next few months by Sony. Sony did not confirm if the HC3 is aligned to be a replacement of the HC1, or it is a lower level version of it (removed the mice jack and zoom ring). Records 1080i HD, 1/3" CMOS sensor, 2,103,000 gross pixel count, Carl Zeiss-Sonnar T* lens, 30mm filter diameter with 10x optical and 80x digital zoom, a focal length of 5.1 – 51mm, with a 35mm equivalent of 41.3mm – 485mm in 16:9 aspect ratio, and 50.5 – 594mm in 4:3 aspect ratio. Gross pixel count of 2,103,000; a 1,076,000 effective pixel count in 4:3 mode; a 1,434,000 effective pixel count in 16:9 mode; a 1,991,000 effective pixel count in 4:3 still mode; and a 1,493,000 effective pixel count in 16:9 still mode. HDMI out.

Sony
High Performance Broadcast
April 2005
HDC-1000 studio ($100,000), HDC-1500 portable ($90,000) cameras, TTM Aug 05.

Both capable of 1080i or 720P HD operations. High-performance 2-megapixel 1920x1080 progressive scan CCDs provide enhanced image quality and stability, native 1080/60P image acquisition with a newly developed video image processor, utilizing the latest 0.11um semiconductor technology.

The 1080/60P performance of the new CCD combined with the camera's image processing algorithm permits an over-sampled 720P signal, resulting in unmatched spatial frequency characteristics and the highest level of 720P performance.

The new cameras operate across the entire spectrum of HD standards including:
Interlace 1080i mode @1080/59.94i, 50i
Progressive 1080P mode @1080/23.98p, 29.97p, 24p, 25p
Progressive 720P mode @720/59.94p, 50P

Integrated down-conversion (SDI or VBS, with or without pull-down), dual HD SDI outputs, and output to VF signals with 60Hz scanning to minimize VF flicker even in 24P mode. Two-channel external control lines can be secured within the fiber system with RS-232C or RS-422 connections for virtual studios. SD monitors can also be used as sub monitors with these cameras.

Sony has made available the HDC-1550 triax interface portable camera for triax-based applications ($96,000, TTM December 05), and an HDLA-1500 large-lens adapter for the HDC-1500 and HDC-1550 cameras.

<u>HD XDCAM</u> cameras with 1080i resolution (right) PDW-F330 ($16,800) and PDW-F350 ($25,800), 3 half inch CCDs of 1.5 megapixel each, use Sony's Professional Disc optical discs for data storage.

Digital Connectivity
A Tutorial

DVI

The DVI (Digital Visual Interface) 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 for the purpose of creating an 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 uses the Transition-Minimized Differential Signaling (TMDS) protocol developed by Silicon Image. PanelLink is the Silicon Image's proprietary implementation of TMDS.

The HDCP (High-bandwidth Digital Content Protection) 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 link between a video source and a display device.

HDCP offers authentication, encryption, and renewability. The Motion Picture Association of America (MPAA) endorsed HDCP as the standard for the secure transmission of HD signals over DVI.

Most new DTV monitors and integrated displays have incorporated DVI or HDMI inputs, although on their first generation some panels were not HDCP compliant, now there is a large volume of H/DTV equipment that is. However, some displays were reported to have interoperability problems regarding DVI/HDCP or HDMI/HDCP.

The DVI standard is able to handle single or dual link connections. A single-link connection supports up to UXGA resolution of 1600 x 1200 at 60 Hz. Dual-link connections provide bandwidth for resolutions beyond QXGA (2048 x 1536).

According to DVI specs a single link has 165 MHz/pixels capacity for 3 channels, Red, Green and Blue, each channel could support up to 1.65 Gbps speed rate, or a total of 4.95 Gbps for the 3 channels (165 MHz x 30 bits x sec). Dual-link connections double that capacity to 330 MHz, with a speed-rate capacity up to 9.9 Gbps.

The 1080i HD format has 1125 total lines of 2200 pixels x frame (active image 1080x1920), requiring 74.25 MHz/pixels (1125 x 2200 x 30fps). Each pixel contains data for RGB and is implemented by DVI with 30 bits (8 per each color plus another 6 for encoding). An HD 74.25 MHz/pixel signal would require 2.2 Gbps speed rate.

A link of 3 channels supporting 165 MHz is sufficient for the 74.25 MHz HD 1080i signal without requiring the use of the second link, and will also be sufficient to transport a 1080p/60 frames x second signal at 148.5 MHz without requiring the second link.

If the signal to be transmitted would be higher than the single link capacity of 165 MHz, it would require the use of a dual DVI link connection, each link will carry half of the signal; the second link cannot be used with just what is exceeding 165 MHz of

the first link. For example, a 200 MHz signal would be carried with both links operating at 100 MHz each.

HDMI uses the same 165MHz capacity per link; dual-link uses the B connector with the second link pins.

DVI identifies and auto-configures the connected device. If source equipment is connected with DVI single link to a display configured as dual link DVI, the image will experience a lower resolution. Some first generation single link DVI cables use dual link connectors. 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. The 29-pin DVI connector uses 24 pins for the digital data stream (12 for each link) and 5 pins (1 plus -shaped blade and 4 pins) to carry analog audio/video and ground.

DVI-I

DVI-D (digital) carries digital-only video data to a display. It is designed for 12 or 24 pin connections, and single/dual link operation (notice the lack of 4 pins, 2 above/2 below the flat blade).

DVI-D

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). The three rows of eight pins have three pins missing in the first row, five missing in the second row and four missing in the third row, and that the "flat blade" contact seen to the left has two contacts above and below it. There is no single or dual link in analog cables.

DVI-A

Regarding connecting plugs to receptacles:

A DVI-D plug can be connected to either DVI-D or DVI-I receptacles,
A DVI-A plug can be connected to either DVI-I/A or VGA (w/adapter) receptacles,
A DVI-A receptacle would accept DVI-I but not DVI-D.
A DVI-I plug can be connected to either DVI-I or DVI-A receptacles (the ‘A’ ignores ‘I’s digital pins)

IEEE1394

IEEE1394 is a 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.

In March 2000, an updated specification was approved, the 1394a. The “a” standard supports speeds of 100Mbps, 200Mbps, and 400Mbps over a distance of 4.5 meters, and up to 63 peer-to-peer nodes/devices.

In 2001, the IEEE 1394 “b” standard emerged as a network technology (rather than as serial bus); it is capable of moving data streams at faster speeds over longer distances than the original.

The “b” standard specifications were intended to support up to 3,200 Mbps depending on the cable material, and permit the use of cabling materials not supported by the “a” standard. It supports speeds up to 100Mbps over 100 meters of Category 5 wiring, 400 Mbps over 100 meters of plastic optical fiber, and up to 3,200 Mbps (or 3.2 Gbps) over 100 meters of glass optical fiber.

The “b” standard is compatible with the “a” standard; if an “a” device were plugged into a “b” component, the bus would deliver a maximum speed limited by the “a” standard (400Mbps). Each “b” device can be set up to 100 meters apart from the next in sequence, allowing the total network to be quite significant in cable length.

The licensing fee for the use of the patented technology is $ 0.25 per system; chipsets are less than $5 each in volume.

It supports hot swapping and plug-and-play, so a consumer’s 1394 bus can recognize automatically a 1394 device when it is connected/disconnected, and reconfigure itself.

The connection is now being used by a growing number of DTV equipment manufacturers for the transmission of compressed HD signals, such as D-VHS recording and networking DTV equipment.

There are three types of cables used for 1394. The 6-conductor type has two separately shielded twisted pairs for data and two power wires in an overall shielded cable with 6-pin connectors on either side. The 4-wire cable uses two separately shielded data cables without power wires in an overall shielded cable with 4-pin connectors on either end. The third type of cable uses either type of actual cable, 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.

6-pin female connector above left
4-pin female connector above right

The 6-pin male connector

4-pin male connector

HD signals are broadcast in compressed MPEG-2 format at approximately 19 Mbps. D-VHS VCRs are able record compressed HD signals and require a 1394 connection to receive the digital data stream. HDTV monitors require a MPEG-2 decoder to decompress the signal for display, as oppose to DVI that is uncompressed.

DTCP (Digital Transmission Content Protection) has been created for the purpose of copy protection 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).

During the last two to three years, there have been many discussions (and hype) about using these types of digital connections (DVI and 1394) for DTV equipment, rather than only the analog connections (component YPbPr, RGB, RGBHV, etc), for protecting HD digital content.

Since 2003, most manufacturers released a large variety of products adopting these two connections to enable their equipment for digital connectivity, IEEE1394 for compressed HD video from integrated TVs with tuners, cable and OTA HD-STBs mainly for recording purposes, and DVI for uncompressed HD video for the viewing of protected content (using HDCP).

HDMI is quickly replacing DVI and is being implemented already on many products, and is becoming the de-facto standard for transporting uncompressed signals over a cable.

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, double what a HD signal would require, and is backward compatible with DVI by using an adapter.

Not included in the standard but used with DVI and HDMI is the HDCP (High-bandwidth Digital Content Protection) protocol. HDCP is licensed by Intel, designed to protect HDMI and DVI signals from piracy, and used for authentication between A/V products. In 2003, a license fee of five cents was applied to each product (four cents for HDMI, 1 cent for HDCP), that manufacturers had to pay to the HDMI founders and Intel.

Digital Connectivity Implementation

HDMI Connectivity (2004-2005)

2004

The company announced the introduction of three PanelLink HDMI Cinema ICs for more features, lower cost per port, DVD-Audio support, higher video resolutions, more sampling frequencies, more HDMI ports, etc:

SiI 9030 transmitter, targeted at the DVD-Audio players/recorders and receivers, supports D-Audio at 32-192kHz frequencies, backward compatible with SiI 9190 1st generation transmitter, 25-112 MHz video bandwidth, compliant w/CEA-861B and HDCP1.1, will support digital audio through S/PDIF digital audio interface, will support Plasma/LCD w/1024 lines (WSXGA).

SiI 9021 receiver, dual HDMI inputs, designed for DTVs, backward compatible with first-generation SiI 9993 receiver chip, compatible with CEA-861B and HDCP 1.1, 25-112 MHz video support for Plasma/LCD w/1024 lines (WSXGA).

SiI 9031 receiver, targeted at Home-theater receivers, DVD-Audio support, sample frequencies of 32-192kHz, dual HDMI inputs, backward compatible w/SiI 9993 first-generation receiver, HDMI 1.0 compatible, CEA-861B and HDCP 1.1 compatible, 32-112 MHz video bandwidth for support of Plasma/LCD (WSXGA) 1024 lines of resolution, support of compressed digital audio through S/PDIF interface.

2005

On January 5, 2005, Silicon Image announced a couple of new 1080p products:

SiI 8100: The first integrated video processor with HDMI/HDCP, HD RGB/YPbPr component video, and SD inputs, targeted to low-cost LCD and CRT TVs. The processor performs video scaling, state-of-the-art 3D motion-adaptive video deinterlacing, programmable hue, saturation, brightness and contrast adjustments, 50 Hz to 60Hz video rate conversion, PIP and picture overlay, and is suited with an 8-bit on-screen display capability for graphics, menus, and EPGs. The SiI 8100 is packaged as a 256-pin LQFP and comes with a complete set of hardware and software development tools for manufacturer implementation. TTM 3Q05 (sampling May 05), $13.95 in 10K quantities,

SiI 9011: HDMI/HDCP low cost third generation PanelLink Cinema Receiver, HDCP repeater, backward compatible with prior-generation SiI 9021, 9031, 9993 HDMI receivers, supports DVD-Audio and 7.1 audio at 96 kHz, and stereo at 192 kHz, interfaces with 12, 24 and 48-bit modes, available in 128-pin LQFP and 144-pin TQFP. LG and a number of other manufacturers are incorporating the IC in their new line of plasma and LCD models. TTM now, $6.95 in 10K quantities (128-pin version).

PanelILink Cinema (PLC) Partners Program

The program was designed to provide consumers with a simple means of identifying HDTVs and other consumer electronics devices capable of receiving and playing the most valuable digital content. The PLC Partners logo assures consumers that HDMI systems bearing this logo have been tested for HDCP functionality and content-readiness, meaning they are interoperable and ready to receive and play premium digital content. Sony, Mitsubishi, Samsung, Hitachi, LG, Sanyo and others have joined the program, which also has broad industry support from content providers The Walt Disney Co., Fox, Universal and Warner Bros. The first PLC-compliant TV, a 50" plasma from LG, was shown at CES 2005. The PanelLink Cinema (PLC) Partners Program was replaced a year later (Jan 06) by the Simplay HD Testing Program, details further below.

HDMI Connectivity Update (2005 – 2006)

HDMI Licensing, 1.2 specification

The licensing agent announced in August 2005 the release of the v1.2 HDMI specification that according to the company includes:

-- Support for One Bit Audio format, such as SuperAudio CD's DSD (Direct Stream Digital)
-- Changes to offer better support for current and future PCs with HDMI outputs, including:
- Availability of the widely-used HDMI Type A connector for PC sources and displays with full support for PC video formats
- Ability for PC sources to use their native RGB color-space while retaining the option to support the YCbCr CE color-space
- Requirement for HDMI 1.2 and later displays to support future low-voltage (i.e., AC-coupled) sources, such as those based on PCI Express I/O technology
-- A minor modification to the electrical specification to ensure compatibility of current and future HDMI receivers with a low voltage, AC coupled transmitter (for example, a transmitter in an integrated graphics chip)

As always, products implementing the HDMI 1.2 specification will be fully backwards compatible with earlier HDMI products.

HDMI first receiver SiI 9033 with v1.2 specification

In September 2005, the company announced the SiI 9033 (3rd generation) dual-input receiver as the first interface able to add SACD capability supporting the v1.2 specification. The receiver would enable the implementation of SACD and DVD-Audio over HDMI at even a lower cost, simplifying the multi-channel digital connectivity using a single cable. The receiver price is available upon request, TTM Oct 05.

HDMI receiver IC support for 1080p

Silicon Image unveiled at CES a 3rd generation IC chip that supports 1080p with iTMDS technology requiring only a single channel consisting of 4 differential signal pairs to support 1080p and the deeper color depths. This chip would enable many 1080p displays to receive 1080p signals externally.

HDMI SiI 1930 and 1390 transmitters

The company announced in January 2006 that leading PC manufacturers such as Hitachi Ltd. and ASUSTek Computer Inc. (maker of 38% of world's motherboards and 4th largest notebook manufacturer) selected their SiI 1930 and 1390 HDMI transmitters for their desktop and notebook PCs allowing for HD video and multi-channel digital audio transmission. Both chips are 64-pin lead free TQFPs with Epad, they are sold for $6.50 in 10000 volume, and offered as sampling and full production.

HDMI SiI 9023 receiver

In January as well, Silicon Image announced a new lower cost 3rd generation receiver SiI 9023 with dual HDMI inputs suited to 1080p resolution, that extends the capabilities of their 2nd generation SiI 9021 receiver costing less ($7.20 for 10000 volume for the 9023). The receiver is packaged as 144-pin TQFP.

SiI 4726 Processor

The company announced in January 2006 their addition of the SiI 4726 processor to the SteelVine Storage Processor portfolio. The 4726 is suited with five 3 gigabit per sec SATA-II ports and best-in-class performance to enable the offering of next-generation plug-and-play storage solutions implementing it as internal or external applications.

In the words of Silicon Image, the SiI 4726 is:

"Capable of supporting up to 2.5 terabytes of storage, the SiI 4726 delivers over 230 megabytes per second of input/output throughput; supports RAID 0, RAID 1 and RAID 10, concatenation, and JBOD (Port Multiplier) configurations; and is capable of enabling multiple RAID partitions on single hard drives, giving the OEM the flexibility to configure the processor to meet varying combinations of capacity, performance and data protection."

"As with all SteelVine solutions, the SiI 4726 works with any SATA-compliant host port -- no driver, BIOS extension, or host software is required -- making the SiI 4726 completely operating system independent. This provides storage system manufacturers the ability to easily target devices with embedded operating systems such as personal video recorders (PVRs), medical equipment, and surveillance systems, as well as any PC or device that runs a commercial operating system such as Windows, Linux or MAC OS X".

Priced at $27 in 5000 volume, TTM now.

HDMI SiI 9020 Transmitter for HD Cameras

Silicon Image introduced in January 2006 the first discrete HDMI transmitter chip for the mobile market, unlike IEEE 1394 connections used for compressed HD, this connection would allow the transfer of uncompressed HD, using less power, and small sufficient for digital cameras and camcorders at resolutions up to 1920x1080 interlaced (1080i), TTM 2Q06, $5.00 for 100K quantities.

Simplay Labs Introduction

In January 2006, Silicon Image announced the launch of Simplay Labs, LLC, and the Simplay HD(TM) Testing Program. According to the company:

"The Simplay HD Testing Program provides compatibility testing for high definition (HD) consumer electronics devices such as HDTVs, set-top boxes, audio/video (A/V) receivers and DVD players, helping manufacturers to achieve compatibility and deliver the highest-quality HDTV experience to consumers."

"Replacing the PanelLink Cinema (PLC) Partners Program, the Simplay HD Testing Program examines devices for compliance with the High-Definition Multimedia Interface(TM) (HDMI(TM)) and High-bandwidth Digital Content Protection (HDCP) specifications, as well as for compatibility with a suite of other devices that have passed the Simplay HD Testing Program. Products that have demonstrated adherence to the Simplay HD Compatibility Test Specification (CTS) in testing by Simplay Labs are identified with the Simplay HD logo.

Simplay HD participants have three testing service options:

-- Simplay Standard -- No annual fee, standard testing fees, standard scheduling, and optional logo usage.
-- Simplay Preferred -- No annual fee, 25 percent discount on testing fees, priority scheduling, logo usage, and website listing.
-- Simplay Elite -- $10,000 annual participation fee, four free tests, 25 percent discount on subsequent tests, priority scheduling, logo usage, prominent website listing, and five hours of test support services per product."

Initial participants in the Simplay HD Testing Program include BenQ Corp., Hitachi Ltd., LG Electronics, MediaTek Inc., Mitsubishi Digital Electronics, Monster Cable, Pace Micro Technology PLC, Renesas Technology Corp., Samsung Electronics, Sanyo Electric Company, Ltd., Scientific-Atlanta Inc., SerComm Corp., Silicon Image, Sony Corp., Sunplus Technology Co., TTE Corp, and Tweeter. The program also has broad industry support from content providers Fox, The Walt Disney Company, Universal Studios, and Warner Bros.

Mitsubishi Digital Electronics, Sanyo Electric Company, Ltd., Sony Corp., and TTE Corp. (under the Thomson brand) have each submitted HDTVs for Simplay HD testing, ensuring that they are compatible and designed to access premium HD content. For a complete listing of Simplay HD verified products, please visit www.simplayhd.com.

SiI 8200 Video Processor

Additionally, in January 2006, Silicon Image introduced the processor above to enable digital audio playback, photo display, and video recording for mass-market TVs. The processor includes dual video processing pipelines, a reduced instruction set computer (RISC) processor, an integrated IDE hard-disk controller supporting digital video recorder (DVR) functionality, integrated MP3/AAC decoders for audio playback, an integrated JPEG decoder for photo display, two 24-bit digital video input ports both support full 1920x1080 progressive (1080p) HDTV resolutions.

Key features of the integrated RISC microprocessor include:
-- 32-bit MIPS RISC instruction set architecture
-- Programmable clock from 600 kilohertz to 166 megahertz
-- 14-kilobyte cache memory

Key features of the video processing pipelines include:
-- Dual processing paths for full support of PIP and POP
-- 3D motion-adaptive de-interlacing for clear reproduction of 480i, 576i, and 1080i video
-- 3D motion-adaptive noise reduction
-- Advanced scaling with moiré cancellation
-- State-of-the-art image processing including DCTI, DLTI, full HSB, and contrast controls

Key features of the integrated storage and mobile player interfaces include:
-- Acceleration for MP3, AAC, WMA, JPEG decoding
-- Integrated IDE HDD controller for DVR functionality
-- Direct connection to flash media for cameras and MP3 players
-- USB 1.1 interface enables direct MP3/iPod playback and photo display from digital cameras

Suited with 388-pin PBGA, $20.00 in 10K quantities, sampling 1Q06, and volume production 3Q06.

iTMDS Internal Link Technology and SiI 7170 Transmitter and 7171 Receiver

Introduced in January 2006, the iTDMS (internal Transition Minimized Differential Signaling) allows for twice the bandwidth of comparable technologies, supports 30-bit and 36-bit RGB color for increased color rendering and detail while reducing the BOM cost. iTDMS extends the TDMS used for external interfaces such as HDMI and DVI to optimize the internal data transfers within HDTVs.

In addition, the first iTDMS IC products, SiI7170 transmitter and 7171 receiver, were introduced to support the specs above up to 1080p resolution using only four differential signal pairs with scalable bandwidth of 25 to 225 megahertz pixel rate input, and DVI 1.0 compliant. The first consumer products implementing iTDMS are expected for TTM 1Q06. The SiI7170 transmitter is in production, packaged thermally enhanced with 128-pin MQFP. The SiI 7071 receiver will be in production by the end of January 2006; thermally enhanced 128-pin TQFP. Both priced as $6 in 10000 volume.

HDMI Version 1.3

In January 2006, the seven HDMI founders announced the key capabilities under development for the next version of HDMI targeted for the first half of 2006. The version includes support for deep color, higher speed, and easier integration into personal computers.

From Silicon Image's press release, those capabilities under development for HDMI include:

-- Higher speed: Though HDMI has more than twice the bandwidth needed to support all HDTV formats, HDMI will increase its single-link bandwidth to support the demands of future HD display devices, such as higher resolutions, deep color, and high frame rates.
-- Deep color: HDMI will support 30-bit, 36-bit, and 48-bit color depths for stunning rendering of over one billion colors in unprecedented detail.
-- Greater PC/CE convergence: HDMI will be enhanced for easier integration into low voltage, AC-coupled PC graphics controllers, cementing HDMI's position as the de facto standard digital multimedia interface enabling true convergence cross PC and CE platforms. The HDMI Founders also support compatibility between HDMI and the Unified Display Interface (UDI), the HDMI-compatible digital video interface for PC displays announced recently by a group of leading PC technology makers.
-- New mini connector: With small portable devices such as HD camcorders and still cameras demanding seamless HDTV connectivity, HDMI will offer a new, smaller form-factor connector option. Since HDMI offers the highest quality digital audio and video on a single connection, such devices will be also benefit from a reduced connector count.
-- Lip Sync: CE devices are employing increasingly complex digital signal processing of high-resolution video and audio formats to enhance the clarity and detail of the content. As a result, synchronization of video and audio in user devices has become a greater challenge and could potentially require complex end-user adjustments. HDMI will incorporate features to enable this synchronization to be done automatically by the devices with greater accuracy.
-- New compressed audio formats: In addition to HDMI's current ability to support high-bandwidth uncompressed digital audio and all currently-available compressed formats (such as Dolby Digital and DTS), HDMI will add additional support for new compressed digital audio formats Dolby TrueHD and DTS-HD.

Products implementing these new versions of the HDMI specification will continue to be fully backward compatible with earlier HDMI products.

HDMI Industry Adoption

According to market researcher In-Stat:

"More than 300 makers of consumer electronics and PC products worldwide have adopted HDMI. More than 17 million devices featuring HDMI were shipped during 2005 and 59 million more are expected to ship in 2006."

Internationally, HDMI is undergoing significant growth. In China, which alone accounts for almost a third of the world's television-owning households, 45 mainland Chinese companies have become HDMI Adopters, and the number is growing rapidly. In November 2005, China's first HDMI testing facility was announced in Shenzen, which will greatly simplify and accelerate the process of bringing HDMI to the Chinese market. In August, the Cable and Satellite Broadcast Association of Asia (CASBAA) recommended that HDMI (or DVI) and HDCP "be included on every set-top box capable of outputting uncompressed high definition content." In Europe, the European Information & Communications Technology Industry Association (EICTA) in 2005 mandated that all HDTVs displaying the "HD Ready" logo must include HDMI or DVI inputs.

HDMI has also gained significant traction in the PC world over the past year. Among the PC-related companies (that also are HDMI Founders and Adopters) are industry leaders such as ATI, Hitachi, Intel, NVIDIA, Sony, and Toshiba.

"The consistent adoption of the HDMI specification by consumer electronics and PC manufacturers proves the high potential of the standard," said Scott Vouri, general manager of multimedia products at NVIDIA. "We believe in the interoperability of consumer electronics devices and personal computers as well as in the ability to view high definition content through a stable and secure standard, and this is why we support HDMI in NVIDIA's consumer PC graphics products."

"Disney has supported the deployment of HDMI since the first version of the specification was issued in 2002," said Bob Lambert, senior vice president of worldwide media technology and development at The Walt Disney Company. "The widespread adoption of HDMI in conjunction with HDCP has played an important role in enabling the transition to digital TV. We congratulate the HDMI community on achieving the important milestone of 300 adopters worldwide."

Food for thought: Are you surprised of Disney being behind HDMI/HDCP and not doing the same effort for backward compatibility with 10 million early-adopters of HDTV with component analog connections?

The latest HDMI specification can be downloaded at no cost by visiting www.hdmi.org

HDMI in 1080p Equipment

As suggested in previous reports, it is always recommended to make sure the HDMI or DVI connections comply with HDCP content protection. I am covering the subject of 1080p in a series of articles in the http://www.hdtvmagazine.com/ , please consult those articles for more details, the first two are included on this document for your convenience.

HDMI chips introduced on the first generation batch did not have 1080p capability; second and third-generation chips have such capability. In order to future proof the video part of a HD system it is recommended that HDMI transmitter/receiver chip sets capable of **transporting 1080p** be used on 1080p HDTVs and other video equipment. According to Silicon Image, the HDMI spec always supported 1080p/60fps, but some manufacturers could have used old (or cheaper) HDMI chip

sets unsuited for 1080p performance, but suitable to other applications, such as TVs that only display 1080i/720p, or DVD players for example.

A manufacturer of 1080p TVs could have decided to use the remaining of an old inventory of those chips because the TV's internal design (before the 1080p display section) might have been already unable to handle the bandwidth required for 1080p, which seems to be the case of almost all first generation 1080p sets out there.

In addition to the 1080p transport feature above, a **1080p pass-thru** feature is useful on external video processor/scalers intended for 1080p purposes, to allow for seamless switching of 1080p input sources (Blu-ray) with other non-1080p source devices (DVD, DTV) connected to the processor. The HDMI chip used must be 1080p capable and the TV processor must refrain from doing any video processing on the inputted 1080p signal, so it can be channeled as cleanly as possible to its 1080p output connected to a 1080p display accepting 1080p (unless the frame rate or scaling need to be changed to match the display native rate).

For additional coverage of the 1080p subject, please review the section of Hi-def DVD.

HDMI Multi-channel Audio

Some articles claimed that HDMI was not implemented by some manufacturers as a full multi-channel connection. The confusion comes from the fact that the majority of first-generation HDMI suited devices were TVs with only two-channel stereo and has no use for the full multi-channel signal. However, most other equipment, from DVD players to A/V receivers, switchers, etc, should be capable to receive, process, mix, or send the full multi-channel audio content across HDMI.

According to Silicon Image, in HDMI there is a two-way communication between the source device and the receiving device by which the receiving device tells the source about its multi-channel capabilities. The source device can then send a matching signal, such as two-channel stereo to a TV, or 5.1 DD channel to an A/V receiver. In other words, the source device adapts to the receiving device when sending the signal.

In the case of an A/V receiver receiving the signal from a 5.1 DD DVD player, both ends of the connection recognize the need to maintain the 5.1, but the receiver might redirect the signal to a TV that needs only L/R channels, for which the output of the receiver adapts on only that output jack by down-mixing the DD stream.

Regarding the newer hi-bit multi-channel audio codecs from Dolby and DTS, it is suggested to verify that the HDMI transmitter/receiver chip installed in both ends of the HDMI link is actually capable to transport the multi-channel audio you plan to play. For example, one legacy application could limit itself to transport the typical Dolby Digital 5.1, another application might require transporting SACD, a feature implemented on chips complying with the current HDMI specification version 1.2.

Earlier transmitter/receiver HDMI chips could have been manufactured based on earlier specification versions and could not be expected to support newer functionality, such as SACD, DTS-HD, Dolby TrueHD, Dolby Digital Plus, etc. For

more information about the applicability and connectivity of these hi-bit audio formats please review the section Multi-channel Audio for HD.

Other Digital Connectivity - Update

IEEE1394 over coaxial

The IEEE1394 Trade Association announced on September 2005 that is developing a specification to enable FireWire to deliver video and audio over coaxial cable to help HDTV be transmitted from set top boxes over coax to PCs and MPEG2 decoders in HDTV format. At 400 Mbps, coax makes it possible for cable operators to implement a high quality network, which could begin to be implemented in 2006, and the spec could be upgradeable to 800Mbps.

Although the 1394 Trade Association has also been developing specs for CAT-5, cable operators favor coax because their customer base is mainly suited with coax.

IEEE Approves Initial 802.11n Spec

In January 2006, the IEEE approved the first draft of the specification for 802.11n wireless networking (184 votes to 0), the final could take another year of revisions, but vendors could use the draft to start designing their future Wi-Fi devices. Some manufacturers already have built products using pre-approved 802.11n specifications; many could be firmware upgradeable to meet the final specs when released later (according to Airgo, a main chipmaker). The 802.11n is better suited for HD multimedia streaming. Although the speed capacity is of 600 mbps, the target is about 300 mbps. The chips are suited with multiple transmitting/receiving antennas to boost radio coverage.

IBM Developed Wireless HD Chip

In February 2006, IBM announced their work in a new chip that would be able to transmit HD wirelessly. The chip is based on the 802.15.3c wireless specification and can operate at more than 600Mb/s within a household range of 10 meters, with the expectation to reach 1.5 Gb/s, within the spectrum of 30-300GHz. IBM has sent developer kits to its manufacturing customers already.

UWB

In January 2006, the UWB Forum and the WiMedia Alliance agreed to discontinue the effort of a working group dedicated to develop and implement UWB as a common standard that would have allowed HDTV wireless transmission within a range of 30 feet.
Samsung, Intel, and Texas Instruments supported the UWB Forum. Freescale Semiconductor bought Xtreme Spectrum back in 2003 and promoted UWB, apart from the WiMedia Alliance.

Freescale and the UWB Forum are working now in an effort to implement UWB for the PC environment (Cable-Free USB) as replacement of USB wiring. Belkin and Gefen introduced products using that technology at CES.

On the other hand, the WiMedia Alliance is pursuing their effort for a Certified Wireless USB technology planned for the end of 2006.

The promise of HDTV wireless using UWB has unfortunately been discontinued in the terms that was initially hoped for, even at 30 feet it would have been short for the requirements of a home network of HD bandwidth.

Hi-bit Dolby Digital Formats - Connectivity

In September 05, Dolby Laboratories announced its newest lossless audio multichannel format, Dolby® TrueHD, for the high-definition optical disc formats, Blu-ray and HD-DVD. The new format claims to be equaled bit-for-bit in performance to the highest-resolution studio masters currently available.

As covered in detail further down, Dolby Digital Plus and Dolby TrueHD have been approved as mandatory audio codecs in the HD DVD format (all players must be able to decode it), while they are optional in the Blu-ray disc format. Dolby Digital is mandatory in both disc formats.

According to Dolby: "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. Enabling recordings that are bit-for-bit identical to studio masters, MLP Lossless was first introduced in DVD-Audio, and has since become the leading multichannel lossless audio format. In addition, Dolby TrueHD provides support for all of the new speaker locations designated by the Society of Motion Picture and Television Engineers (SMPTE) for digital cinema applications (RP 226)."

New delivery formats that can support at least a 2 Mbps bit rate for audio are potential software candidates. The first applications to adopt Dolby TrueHD are Blu-ray Disc and HD DVD, as these can support up to 18 Mbps for audio.

Next-generation Hi-def players are being designed to include features like interactivity and audio mixing which require the audio to be decoded in the player instead of the A/V receiver. A Dolby TrueHD multichannel decoder in the player will be the only way to ensure that listeners will hear the full quality of the wide range of audio capabilities.

Unlike perceptual or lossy data reduction, lossless coding does not alter the final decoded signal in any way, but merely "packs" the audio data more efficiently into a smaller data rate for storage or transmission. The lossless version always sounds like the source. The lossy version may sound like the source, but this is not guaranteed. The perceived quality of a lossy audio format depends on many factors, including the nature of the source material, the compression efficiency of the codec, the delivery bit rate chosen, the quality of the playback hardware, and the listening environment.

Dolby TrueHD also provides unique support for stereo playback, either via a programmable downmix or a wholly separate stereo mix, ensuring that surround content creators can deliver the companion stereo mix exactly as they intend, without compromise. Dolby TrueHD for next-generation high-definition media delivers sampling frequencies from 48 to 192 kHz and word lengths from 16 to 24 bits. The sample rate and word length for Dolby TrueHD content will always be the same for all channels.

The bit rate needed to deliver a Dolby TrueHD lossless track depends on the characteristics of the source material, bit depth, and sampling frequency. Dolby TrueHD for next-generation high-definition media can operate at data rates up to 18 Mbps. All new players incorporating Dolby TrueHD technology will support this maximum data rate.

Dolby TrueHD for next-generation high definition media supports up to eight channels of audio, and offers expandability to accommodate more channels in the future while retaining compatibility with all Dolby TrueHD decoders. The Dolby TrueHD stream is structured so that a player only needs to decode the number of channels it needs. This ensures that a single Dolby TrueHD stream can be used to deliver a two-, six-, or eight-channel presentation with precise control over the playback defined by the content producer.

Dolby TrueHD is designed to offer comprehensive metadata functionality similar to that found in Dolby Digital and Dolby Digital Plus. This includes down-mixes that are defined by the content producer, dynamic range compression for late-night listening, and dialogue normalization to ensure consistent playback loudness between different content. For future content featuring discrete 7.1-channel playback, Dolby TrueHD also supports multiple 7.1 configurations.

The following highlights the various multichannel audio connections between near future High Definition DVD players and A/V Receivers for the Dolby formats.

Disclaimer: the information of connectivity and graphs included below is provided courtesy of Dolby Laboratories with permission.

In HD disc players, the audio will be handled in much the same fashion. Soundtracks decoded from the disc, as well as audio elements streamed or downloaded from an Internet connection or generated internally in the player will be decoded in the player as digital PCM signals. PCM is the format players use to perform all internal audio processing operations, including mixing. In the mixing stage, streaming commentary, button sounds, and other non-disc-audio will be mixed with the native 5.1 or 7.1 soundtrack from the disc. The result will be the complete audio presentation as intended by the content maker.

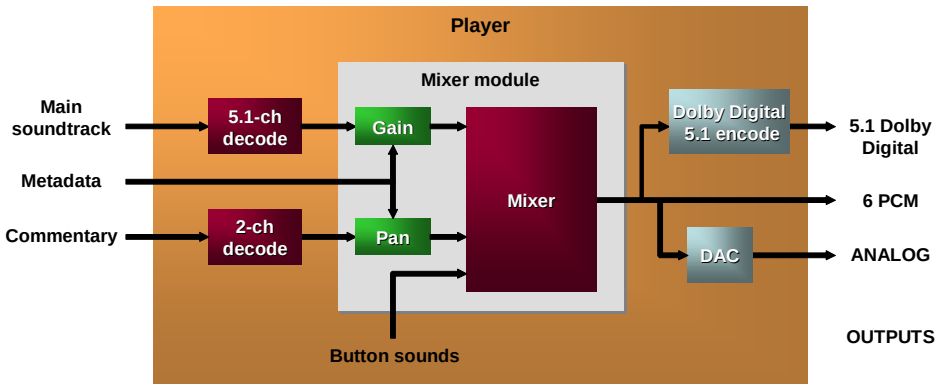


Figure 1 - Next-Generation Six-Channel Optical Player with Dolby Digital Output Encoder

The implications of this decoding within the player are significant. New features can be created for a given title long after the discs have shipped. More importantly, the fact that players will be mixing the audio internally means that it will no longer be possible (or necessary) to output raw audio bitstreams from the player as is typical with DVD-Video. As a result, consumers can no longer assume that every player will work with every A/V receiver.

Two methods already exist for reproducing the high-resolution soundtracks of next-generation optical formats through your A/V receiver or audio processor.

Single-Cable Digital Connection

Increasingly, A/V processors and receivers are being equipped with IEEE 1394 (FireWire®) or HDMI connections, capable of transporting up to eight channels of 24-bit/96 kHz PCM audio content. If your A/V receiver is equipped with this type of next-generation connection, you should look for a similarly furnished next-generation optical media player. By this method of connection, the mixed PCM signal is transported from the HD player to your A/V receiver, where digital signal processing and bass management can be easily effected.

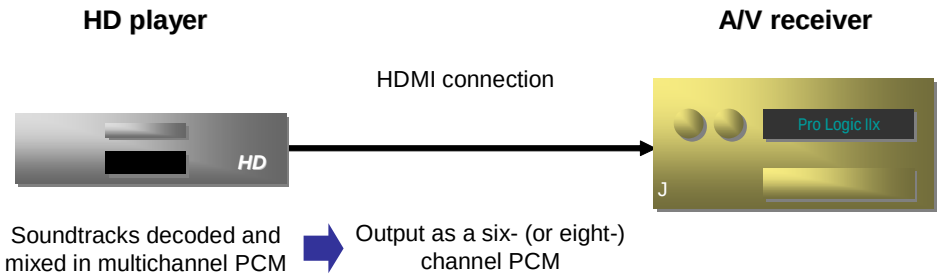


Figure 2 - Connection via Current HDMI

Multichannel Analog Connection

A next-generation optical player may also include line-level audio outputs sourced from the multichannel mixed PCM signals passed through digital-to-analog converters. The advent of SACD and DVD-Audio in recent years has led to the incorporation of 5.1 and even 7.1 external inputs on many A/V receivers. If your A/V receiver is equipped with 5.1 or 7.1 external audio inputs, the selection of an optical player equipped with 5.1- or 7.1-channel line-level outputs will provide full-bandwidth reproduction of the audio signal originating from your HD player.

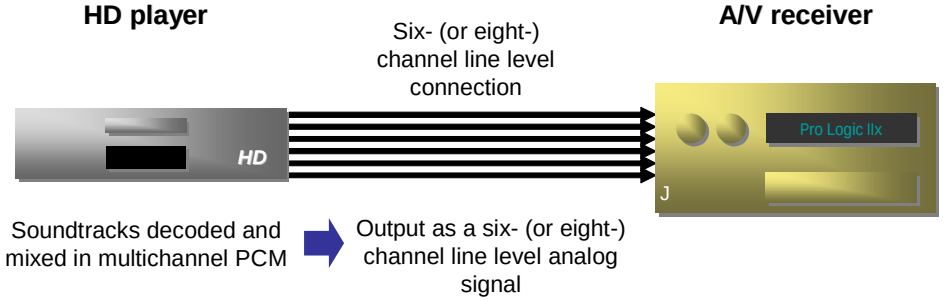


Figure 3 - Connection via Multichannel Analog Inputs

A connection through either of these existing interfaces will let you experience the full potential of the high-resolution audio delivered on next-generation optical formats.

S/PDIF Connection

If your A/V receiver or processor has neither multichannel analog or digital inputs, but is equipped with 5.1-channel Dolby Digital decoding and playback, you will still be able to enjoy 5.1-channel performance from next-generation optical players. Included within 7.1-channel multichannel Dolby Digital Plus and Dolby TrueHD streams is a core 5.1 mix prepared by the content maker that is used when the player is set for 5.1-channel mode.

After playback audio signals have been mixed in the player, the PCM signal can be encoded to a Dolby Digital signal and output from the player via S/PDIF (optical or coaxial) to your connected Dolby Digital A/V receiver or processor.

In many instances, the audio quality you will experience from this connection may be better than what you would experience during playback of standard-definition DVD-Video discs, especially if the native signal on the disc is Dolby TrueHD or high-bit-rate Dolby Digital Plus. This is a direct result of a higher-quality source signal feeding a Dolby Digital encoder running at 640 kbps—higher than the maximum bit rate on DVD-Video.

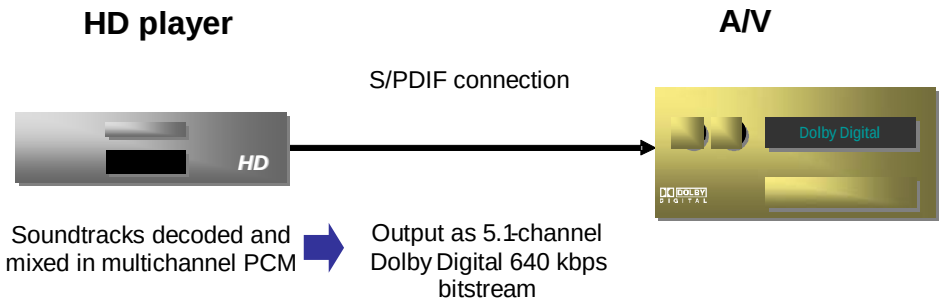


Figure 4 - Connection via S/PDIF

Because Dolby Digital encoding (*of the audio mixes over the soundtrack, RLM)* support is optional in HD players, you will need to look for a next-generation player equipped with an S/PDIF output and built in Dolby Digital 5.1-channel encoding technology.

Dolby TrueHD and Dolby Digital Plus in A/V Receivers

Eventually, A/V receivers will have direct access to Dolby Digital Plus or Dolby TrueHD bitstreams. Dolby is working with the IEC and HDMI organizations to update data protocols to enable future versions of these high-bandwidth interfaces to carry these bitstreams.

To decode these bitstreams, the A/V decoder will need to support the updated data protocols, as well as incorporate these new decoding algorithms. In addition, it will be necessary to select HD discs in which the content maker has permitted the core 5.1 or 7.1 audio bitstreams to bypass the player's mixing process and be sent directly to the digital outputs of the player. We expect that certain HD discs will permit this, but they may represent a minority of titles. In the end, the sound quality will be essentially the same as audio that was decoded in the player as PCM and transported it through a current generation HDMI connection to the A/V receiver.

With six or eight channels of 24 bit/96 kHz audio transported from these new HD formats, post-processing DSP requirements for an A/V receiver more than double. Rather than devoting the considerable DSP resources to decoding the core audio signals within the A/V processor itself, it may be more fruitful to use the A/V processor's DSP resources to perform high-resolution post-processing such as bass management, room or speaker equalization, Dolby Pro Logic® IIx decoding, or other types of digital signal processing.

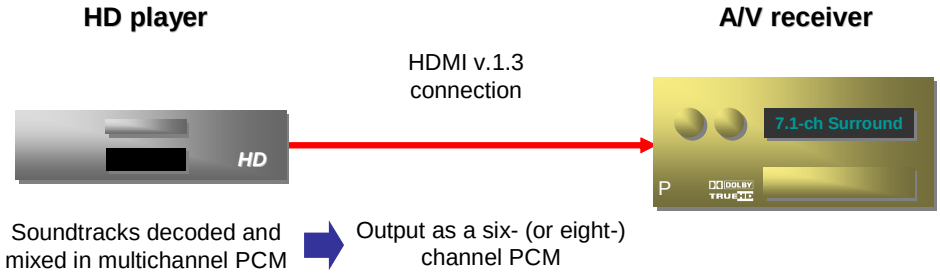


Figure 5 - Connection via Next-Generation HDMI

As a result of the quality and capabilities that the new digital interfaces provide, hardware manufacturers can offer more highly optimized system designs that attain the ultimate in performance while providing the greatest flexibility and efficiency for the consumer.

Disclaimer: this concludes the connectivity information sourced from Dolby Laboratories.

Legacy Discrete Surround Audio Formats for Hi Def DVD

In October 2004, the DVD Forum and the Blu-ray Disc Association approved mandatory and optional audio formats for both Hi Def DVD standards.

Both groups approved the legacy Dolby Digital 5.1 and DTS 5.1 discrete audio surround formats as mandatory for HD players on both formats, which also ensure the audio playability of 5.1 multi-channel DVDs when played on HD players.

However, both High Def DVD formats declared optional the player's ability of decoding 6.1 DTS channels. Regarding the disc itself, at least one of the legacy formats must be included on the pre-recorded discs, at the choice of the content provider.

Hi-bit Surround Audio Formats – Summary

Dolby Digital Plus

Dolby Digital Plus is a flexible codec based upon core Dolby Digital technologies. For broadcasters, it provides higher efficiency coding at lower bit rates. For the new blue laser 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 an efficient 50% (192Kbps) data rate of regular Dolby Digital (384Kbps). Compatibility with all existing Dolby Digital consumer decoders is ensured, as the Dolby Digital Plus signal will be upconverted to a standard 640Kbps Dolby Digital Plus output in the set top box (but the 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 capable of a higher-bit rate enhancement 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. Dolby Digital Plus has no ability to carry uncompressed audio nor can it be operated in a lossless way.

DTS-HD (and ++, Master Audio)

DTS announced that their new lossless DTS++ (as named originally) 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 Mbps extension of the same lossless format under a new name, DTS-HD Master Audio, 100% lossless and bit-for-bit identical to the studio master, as claimed by DTS.

DTS-HD uses 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, while delivering audio quality at bit rates extending from legacy DTS Digital Surround to 7.1 DTS-HD channels, using a single stream up to 18Mbps.

Dolby TrueHD

Dolby TrueHD can support up to 14 discrete of lossless 24-bit/96 kHz audio channels at bit rates as high as 18Mbps, although HD DVD and Blu-ray Disc standards currently limit their maximum number of audio channels to eight. 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.

Hi-bit Audio Application to Hi-def DVD Formats

In September 23, 2004, Dolby Laboratories announced that the DVD Forum decided to include Dolby Digital Plus and MLP Lossless, the core audio technology behind multichannel DVD-Audio, as mandatory audio standards for HD DVD. Later, Dolby TrueHD was also selected as mandatory audio format for HD DVD. However, both Dolby formats were selected as optional audio formats for Blu-ray players.

DTS-HD was declared as optional for the players of both Hi-def DVD formats.

In other words, Blu-ray approved as optional the 3 hi-bit audio formats (Dolby Digital Plus, Dolby TrueHD, and DTS-HD), the only mandatory codecs for Blu-ray are the legacy 5.1 DD and DTS.

According to Silicon Image, the HDMI transport is able to handle 24Mbps of audio speed, suitable for any of the proposed audio formats from either disc format, including DTS HD Master Audio. However, the version 1.3 HDMI specification would enable the players to output those audio formats over HDMI, those protocols and specifications are expected to be finalized on the first half of 2006. Dolby is working closely with Silicon Image to ensure transmission of Dolby Digital Plus and TrueHD signals on HDMI v. 1.3.

As an alternative, HD players with internal hi-bit-rate decoders are expected to also have 6.1 or 7.1 analog outputs that could support the hi-bit-rate and be connected to receivers with 6.1 or 7.1 channel analog inputs.

Analysis

My first human reaction: How many more multi-channel audio formats a consumer needs? How many more connections, A/V receivers, and audio-processors a consumer needs to continuously upgrade in this multi-channel matrix/discrete, lossy/lossless, low-bit/hi-bit, 5/6/7.1 marathon? How many consumers actually invest beyond 5.1 low-bit lossy because they find a difference their ears and pockets justify as considerable benefit? Where is the significant content with more channels to justify more decoding/amps/speakers at a legacy 5.1 consumer's home?

The large capacity of Hi-def DVD brought with it an invitation to use part of the vast space to pursue cleaner multi-channel audio for the soundtrack of a movie, but the lossless hi-bit audio space requirements to allow a maximum/approved speed of operation of 18Mbps are reaching levels that could even exceed the space requirements of the HD video itself in the same disc (using VC1 for example), not to mention using DTS HD Master Audio maxing at 24 Mbps, the risk of exceeding the capacity of a dual layer 30GB HD DVD disc, or even a 50GB Blu-ray disc depending the combination of video and audio codecs used, and that is storing just one hi-bit lossless codec in the disc, about trying to fit two, such as the typical Dolby/DTS pair, now in hi-bit? Make the math with just one.

In other words even when using a dual layer approach the discs might be limited to include only one of the hi-bit multichannel audio codecs, and possibly be very close

to the speed capacity of the format when a non-aggressive compression HD video codec and the hi-bit lossless audio are played simultaneously, as usually is the case.

In September 2005, Dolby announced that A/V receivers capable of processing PCM over their HDMI 1.1 inputs should also be able to have sufficient bandwidth to accept the HD video and the PCM multi-channel audio decoded by the Hi-def DVD player. Any HDMI suited receiver should be capable to input the PCM and reproduce the higher bandwidth of the soundtracks. Initially, it was believed that those HDMI 1.1 suited A/V receivers would have to use analog cables from the multi-channel audio connectors (as with DVD-Audio), and wait until specification version 1.3 of HDMI be completed (and eventually change to a 1.3 compliant A/V receiver).

According to Dolby, there should be no need to replace an HDMI 1.1 suited receiver to get the benefit of the higher-bit audio formats. However, when using the latest HDMI version 1.3 from player to receiver, the decoding would not have to happen in the player, the connection would stream the native mandatory and optional audio formats to the HDMI 1.3 suited A/V receiver, which would perform the decoding job. Reportedly, DTS intends to suit players as well as receivers with their decoders, Dolby was quoted as concentrating initially on players.

Hi-definition DVD disc players are expected to support Internet-streamed audio content (such as director's comments) while playing the movie, and they have to internally mix the various audio components (soundtrack, Internet, PCM sounds, etc) before converting the final audio mix to individual PCM channels to be output over the HDMI connection.

The newer hi-bit formats, Dolby Digital Plus lossy, Dolby TrueHD lossless, and DTS HD lossless (previously named DTS++ lossless, and now extended to Master Audio 24 Mbps), are much faster than the supported speed of typical digital coaxial connections (S/PDIF) used for the current legacy Dolby Digital and DTS multichannel audio formats, however, those legacy connections would still transport the down-converted legacy versions (derived from the hi-bit) produced by Hi-def DVD players.

As mentioned above, if an existing receiver does not have HDMI inputs it can still use the multichannel analog connections (6 to 8 RCA type of connections) until is time for the upgrade; remember the convenient DVD-Audio mess of wires?

In selecting a Hi-def DVD player of any format, one factor of choosing one model over the other could be the implementation of the Hi-bit multichannel codecs that are optional (Dolby TrueHD, Dolby Digital Plus, DTS HD, depending on the format).

Even when not having the latest A/V receiver that could decode the Hi-bit formats itself using the HDMI 1.3 connection, if a consumer is interested in a system to reproduce the optional DTS-HD for example, that consumer would be making a better investment by choosing a Hi-def player that decodes DTS-HD by itself. The existing receiver, using the alternative connections above, would be spared from an unneeded upgrade just for that purpose.

There are players that were announced with various combinations of optional codecs, one Blu-ray player was announced to support DTS HD but not Dolby TrueHD, another player supported True HD but just as a 2 channel feature. A manufacturer is not obliged to suit the player with optional codecs, so a closer look at the specs would help on the selecting decision of the player, or even the format.

Logically, the multi-cable analog connection alternative above assumes the receiver "has" those analog connections typically used for DVD-Audio, not all do. In which case the Hi-def DVD player would do the multi-channel decoding and the D/A conversions for each of the 8 channels, 8 cables would carry them to the analog inputs of the receiver, which would convert them back to digital to perform any digital processing the receiver needs to do before the amplification stage of each channel to reach the speakers. Quite a few conversions for that solution, not as clean as a direct digital connection but still a way to get the benefit of new codecs.

Since a player is also expected to make available the lower bandwidth compressed lossy versions (DD at 640kbps, and DTS at 1.5 Mbps) of those hi-bit formats over the typical S/PDIF digital connections, a consumer has another fallback plan of connectivity to older receivers, other than the analog connections, until equipment could be upgraded. Audio mixes over the soundtrack would be missing though.

Although I could not verify the following in detail myself, Dolby was quoted stating that certain formats would not be able to be down-compatible 100% using the digital coax legacy connections, such as:

7.1 channels of 96/24 PCM at 18.4Mbps (in both Hi-def DVD formats)
HD DVD's two channels of 192/24 PCM at 9.2Mbps
Blu-ray's optional 6-channel uncompressed 192kHz/24-bit PCM at 27.6Mbps

In summary, there will be a variety of backward compatibility connectivity options to allow consumers to still be able to use the existing audio equipment at their current multi-channel audio capabilities when playing back the new audio formats of High Definition DVD discs/players, but there will be enough incentive for upgrades.

Upgrading to an A/V receiver suited with HDMI 1.1 would bring the full benefit of the lossless audio formats transporting the channels digitally as PCM, and if the upgrade could be done to HDMI 1.3 connectivity it would open the possibility to do hi-bit decoding on the receiver, giving the consumer the option of doing the audio decoding in the A/V receiver or the player, which ever sounds best for the consumer, and perhaps been able to decode a hi-bit codec missing in the player but the receiver has.

In that scenario, the player would just stream out of HDMI the undecoded hi-bit multichannel signal for the A/V receiver to decode, expanding the flexibility of the audio part of the system. However, check the specific conditions on the charts above, it seems that using the HDMI connection for streamed audio (not PCM) might disallow the mixing of the additional audio features of Hi-def DVD over the soundtrack, unless the player is suited with an optional, and probably unusual, "encoder".

DTV Content Protection Rulings and Agreements

Note: I wrote this analysis for an article published by the HDTVetc Magazine in April 2004, the information still applies today but to be more useful I updated a few paragraphs, marked as (update made Feb 06).

This subject has been covered by the press and other magazines over time in bits and pieces; in order to provide you with a complete perspective I prepared this simplified analysis of the approved FCC rulings, the areas not ruled yet, and how their integration could affect you as an HDTV adopter.

'Plug-and-Play' Cable Agreement (Applicable Also to Satellite)

On issue 3 of the HDTVetc magazine, I wrote an article about integrated tuners, which briefly touched the subject of content protection within the 'Plug-and-play' cable agreement approved by the FCC, but it was from the perspective of hardware functionality and cost/benefit analysis of integrated vs. separate HD tuning devices, for satellite, cable or over the air reception.

On this article, I will go deeper into the subject on content protection to analyze the combined effect of the 'Plug-and-play' cable agreement, together with the 'Broadcast Flag' ruling, and the 'analog hole' issue, not ruled yet. I will explore the ramifications when interacting with each other when viewing and recording of HD content. I will also analyze the areas of the rulings that seem not specific or not clear enough.

As stated on the previous article about the subject, on December 2002, an announcement was made of an agreement between the consumer-electronics and cable television industries regarding digital cable interoperability as follows:

"The agreement is part of a broad 'memorandum of understanding' between the two industries that is intended to lead to a 'plug-and-play' standard that was needed to link digital cable equipment and services with consumer electronics devices. Once the Federal Communications Commission approves the agreement, it is expected to help speed the adoption of HDTV.

The memorandum, along with a letter to FCC chairman Michael Powell, was signed by 12 consumer electronics companies and seven major cable multiple system operators (MSO) representing more than 75 percent of all cable subscribers. The memorandum is a package of voluntary commitments, specifications and proposals for rules covering digital television (DTV) cable hardware compatibility and content protection, and the FFC is expected to approve the recommendations".

The plan includes the phased-in use of two digital interface connectors on new digital cable-ready TVs and/or cable set-top converter boxes.

Those are: a) IEEE1394 'FireWire' connections with Digital Transmission Content Protection (DTCP) for recordable and networkable compressed video streams, and b) the non-recordable DVI/HDMI with High-bandwidth Digital Content Protection (HDCP) connections on digital televisions and cable set-top boxes.

The agreement prohibited Multi-channel Video Programming Distributors (MVPDs), mainly cable but also applicable to satellite providers, who use STBs with both 'FireWire' and DVI/HDMI connectors to switch the outputs in order to restrict lawful

recording ('selectable output control'). The agreement also included encoding rules to 'copy freely, once, or never', depending on the content, modeled from the Digital Millennium Copyright Act. The CEA announced in September 2003:

"Digital cable ready HDTV owners will be provided with a secure CableCARD to be inserted into the digital receiver in order to comply with varying degrees of content copy protection levels and prevent theft of cable service. For instance, at least one copy of a digital channel sold by monthly subscription (e.g. basic and HBO) may be made for private and personal use, whereas premium pay-per-view and video-on-demand programs may be marked as copy never (originally as copy once). Free over-the-air broadcast signals may be copied freely, and may not be reduced in resolution ("down-res'd") when output from unprotected high definition analog ports."

"Significantly, legacy DTV set owners also are protected by this agreement, which bans the use of "selectable-output-controls," which would have enabled content providers to control content delivery to households from the head end. Without the plug-and-play agreement's encoding rules, consumers who purchased introductory HDTV sets not equipped with copyprotection-designed digital outputs could be disenfranchised and altogether denied HDTV services and programming. This agreement ensures that today's DTV products will not be made obsolete in the course of a transformation to nationwide digital video delivery over cable. <u>But selectable output controls may some day in the future be used</u>." (Underline added).

I would like to mention that even though the spirit of the agreement was protective of the investment made by millions of early adopters of HD equipment with just analog connections, some loose ends were left open for further resolution (read as 'further negotiation with the MPAA').

One loose end is the underlined statement above (*But selectable output controls may some day in the future be used);* another loose end is the possibility of 'down-res' non-broadcast content over legacy component analog connections (the FCC prohibited 'down-res' but only for broadcast content).

As approved almost a year later, the ruling set the following deadlines: Starting April 1, 2004, cable operators must supply upon request HD-STBs with functional IEEE1394 'Firewire' connectors, and by July 1, 2005, all HD-STBs would also require a Digital Visual Interface (DVI) or High Definition Multimedia Interface (HDMI), both protected with High-bandwidth Digital Content Protection (HDCP).

These digital connections would permit protected HD viewing (DVI and HDMI with HDCP) and recording (IEEE1394 with DTCP), depending upon the copy protection rules applied to such content (copy freely, once, or never).

The 'Plug-and-play' cable agreement decisions (copy freely, once, never; and 'no-down-res' of broadcast content) were also applied to satellite service providers (which are MVPDs as well). At that time, they said they were not a party on this FCC decision, and declared that it was not the end of the process.

Broadcast Flag

Not as glorious as the flag we all defend and love.

In November 2003, to limit the indiscriminate redistribution of digital broadcast content, the FCC approved the 'Broadcast Flag' anti-piracy order. A digital code embedded into a digital broadcasting stream would signal DTV reception equipment to activate the redistribution limit. The mandate was to take effect in July 1, 2005, but as you would see on the next section of this report, the Broadcast Flag order was overturned by a Court of Appeals in Washington DC, although it appears to be a temporary situation (*update made Feb 06*).

The FCC allowed broadcasters to decide whether or not to include the flag with specific types of programming, but declined to prohibit the use of the flag with regard to certain types of programming, such as news or public affairs, an issue that consumers and free-speech advocacy groups had demanded not to restrict.

Two of the five commissioners disagreed with the section that dealt with restricting also news programs, and content with expired copyrights, which would affect the sharing of such video clips over the Internet.

This regulation excludes digital devices not built with internal digital tuners, such as existing digital VCRs, DVD players, personal computers, etc. According to the FCC ruling, all existing equipment incapable of reading the broadcast flag, such as televisions, VCRs, DVD players, will remain fully functional.

The new rules still allow consumers to make digital copies of broadcast HD content; they are intended to prevent only the mass distribution over the Internet, and to encourage availability of 'high value content' on broadcast television by discouraging its migration to more secure platforms such as cable and satellite TV service, according to the FCC.

In the words of the FCC ruling documents, "The broadcast flag protects consumers use and enjoyment of broadcast video programming. The flag does not restrict copying in any way".

A demodulator (within equipment capable of tuning DTV) that complies with the flag mandate could still send the tuned signal to the analog component outputs of the device, but only to those digital outputs that meet with a copy-protection technology approved by the FCC (possibly 5c).

The FCC still needs to go thru the process of approving those future copy-protection broadcast-flag technologies; several are already pre-approved, including 5c. Companies that are part of the Broadcast Protection Discussion Group developed those technologies. Vendors of a particular content protection or recording technology need to be certified by the FCC in that such technology is an appropriate tool to give effect to the broadcast flag.

In another statement of the FCC documents it is indicated: "We concur and find that redistribution control is a more appropriate form of content protection for digital broadcast television than copy restrictions. This determination is in keeping with our earlier decision to prohibit copy restrictions on unencrypted digital broadcast television when retransmitted on MVPD systems."

Following are some interesting fragments of comments made in the proceedings of this ruling:

"If first run DTV broadcast content were freely available over the Internet, then secondary, international and web cast markets could be threatened";

"MPAA cautions that if current trends in compression efficiency, storage capacity and broadband speed persist, then in a few years it will take less time to download a high definition movie than to watch it";

"Critics suggest that this threat is overstated and that limits to existing broadband capacity will prevent widespread Internet retransmission of high definition digital content for the immediate future. One estimate indicates that it could take as much as four days to upload a one hour HDTV broadcast program to the Internet at standard consumer broadband speeds".

Other Technology Alternatives to the Flag

Some sources in the ruling suggested that the flag could be easily circumvented by using digital to analog converters and that there is concern that the presence of component analog outputs on ATSC tuners would provide a weakness point for the protection offered by flag recognition technology, because it would remove the content protection ('analog hole').

Non-compliant legacy devices will output content without recognizing the flag, critics say "non-compliant hardware or software demodulators could be produced with relative ease by individuals with some degree of technical sophistication."

Several technological options, such as watermarks and forensic fingerprinting, were discussed with the inter-industry Analog Reconversion Discussion Group ("ARDG"). Digimarc, Macrovision, and Philips supported the use of watermarking to secure DTV broadcast content. Philips also argued, "an encryption regime should be considered critically because it could potentially limit the playback functionality of legacy recording equipment."

Other sources on the FCC proceedings recognized that encryption would not resolve the 'analog hole' problem, and commented that the watermarks mechanism was considered a more complete solution than the ATSC flag since watermarks are embedded within content and can survive digital and analog processing as well as format conversion, which makes it suitable for redistribution control purposes and also to address the analog hole. Watermarks could even be used as a complementary method, in addition to the broadcast flag, to solve the issue of component analog outputs.

Some specific comments on alternate mechanisms stated "Digimarc and Macrovision assert that the implementation costs for watermarking are similar to the costs associated with a flag regime, and that watermarks can be made backwards-compatible with legacy devices. In a similar vein, Philips believes that a specific type of watermarking technology known as fingerprinting may evolve into an appropriate mechanism to address both redistribution control and analog hole concerns."

Even when considering the robust security generally associated with encryption technologies (as stated in the proceedings), it was anticipated that the implementation costs and delays would make it a less desirable content protection system for DTV broadcasts than the ATSC flag.

The proceedings viewed the obsolescence of legacy equipment as particularly burdensome on consumers, and there was no enough evidence to support that "the security benefits gained from encryption outweigh the costs that would be levied on consumers."

In another comment from the proceedings, it was expressed that "given the anticipated growth in DTV equipment sales over the next few years, we conclude that the development time needed for an encryption system would exacerbate the existing legacy problem and frustrate early adopters. As such, we decline to adopt encryption at the source as a content protection mechanism for DTV broadcasts."

Regarding watermarks and fingerprinting it was resolved that "as new content protection technologies develop, watermarking and fingerprinting may emerge as useful tools to protect DTV broadcasts. At this time, however, the record reflects that these technologies are insufficiently mature for implementation."

Down-res

The 'Down-res' nightmare is already seven (*update made Feb 06*) years old, and is still haunting us, what is 'Down-res'?

Imagine tuning to an HD signal (1080i or 720p resolution) and not been able to view/record it as true HD, but only as an SD downgraded version of it (480i resolution). This is not due to DTV equipment technical limitations, which we all know there are from the camera to the home, it is intentionally imposed by the content provider, reducing it to 16% of the 1080i original version (1080ix1920 = 2,073,600 down converted to 480ix704 = 337,920, both at 30 frames per second rate).

There is the possibility that the down-res be done at the level of ED (480p) or as it just happens now with the AACS down-res of High Definition DVD approved as 540x960 or 25%, please check further down the AACS ruling *(update made Feb 06)*.

This assumes (the dream) that the full potential of the HD interlaced 1080i standard is/could be actually recorded with capable cameras and transmitted as 1080ix1920, and can actually be displayed at your home as 1080ix1920. There are in the market a few high-quality (expensive) 9" CRT displays and more recently, 1080p fixed-pixel-display sets that should resolve that resolution (*update made Feb 06*), but most sets do not. However, even with such limitations, 480i is still a severe downgrade that can be easily visualized when compared to 1080i, especially in the large screens of most HDTVs of today.

In other words, if you invest on an HDTV and an HD-STB without protected digital connections you run the risk of eventually not been able to view some HD protected content as true HD when using their component analog connections.

Before getting deeper into the subject, a little bit of history could be useful. Since the first introduction of HD-STBs in 1998/9, it was known that satellite service providers have the capability to deactivate from their end the analog component connections ('selectable output controls') of the HD-STB, or to reduce the resolution

('down-res') on such connection, when/if the owner of the content requires the MVPD to protect the program.

Dish Network was known to oppose to such practice and hoped never to have to use the option; as a contrast, DirecTV never opposed to it and tested HDCP as a copy protection method over a DVI digital connection over a year ago; that gave us a warning sign.

Judging by DirecTV's continuous resistance to the installation of IEEE1394 outputs on their HD-STBs, so subscribers cannot archive/record HD content on D-VHS tape (and no networking in HD), it would not be a revelation if DirecTV would actually end up implementing 'down-res' on non-broadcast content over analog connections (see below their request of February 13, 2004).

Even the first DirecTV HD-STB introduced six years ago (the respected RCA DTC-100) with only component analog outputs, highlighted in the user manual, and in the packaging box, that some HD programming might not be viewed with this HD receiver, the actual disclosure follows:

"*Due to copyright restrictions, you may not be able to record or view some high definition programs in high definition format using this product. To view this type of programming in standard definition format, you must also connect the Audio/Video jacks to the monitor.*"

The 'down-res' objective was implemented as 'selectable output control', which forced the viewer to switch to the regular TV inputs to at least view 'something'. Newer STBs are designed to perform the 'down-res' over the same component analog connection, no need to switch TV inputs; either way, the resolution of the viewing is degraded to SD.

Although the industry started in 2003 to include digital connections (DVI, HDMI) in a large number of HD equipment, the vast majority of the 9 million HDTV sets and STBs sold until 2004 still have only component analog connections.

As stated before, the FCC already ruled by prohibiting MVPDs to 'down-res' to protect early adopters in the 'plug-and-play' cable agreement, which also prohibits the use of 'selectable output controls'. However, the 'down-res' prohibition was for broadcast content only, as follows:

"Down-resolution – Down-resolution (reducing the resolution of high-definition programming to standard-definition) is prohibited for broadcast programming by all MVPDs; the FCC said that down-resolution of non-broadcast programming will be addressed in the Further Notice. In the interim, MVPDs intending to use down-resolution for non-broadcast programming are required to notify the FCC at least 30 days in advance."

In February 13, 2004, DirecTV requested to the FCC to allow them to 'down-res' certain non-broadcast programs over the component analog connections of their HD-STBs, anticipating that some movie studios will not make available to them some of the more popular movies if using unprotected outputs.

The Consumer Electronics Association declared that they want the FCC to keep the 'plug and play' rule of 'no down-res' as introduced, although what DirecTV is

requesting is for non-broadcast content, the 'analog hole', which was not yet addressed by the FCC.

Due to remaining negotiations with the MPAA regarding the protection of their content over analog connections ('analog hole'), and also due to DirecTV's recent request for 'down-res', millions of early adopters are haunted again with the possibility of restricting HD viewing on legacy equipment with analog connections.

The FCC, the CEA, the MPAA, and the MVPDs, would have to employ all of their negotiation skills to solve this matter to the satisfaction of everyone, not to mention the right of a consumer to watch a paid HD movie/premium channel in its full resolution.

Analysis - Some Loose Ends

The term "indiscriminate redistribution" used in the content-protection order of the Broadcast Flag is to prohibit Internet redistribution to stop piracy (if anything could actually ever stop piracy).

New HD PVR devices record content for time shifting, some also perform as home servers that store HD content able to be distributed to other network devices throughout the house (*update made Feb 06*).

The new ruling is not specific enough about how a proposed content protection technology (including those the FCC did not approve yet) would allow HD home networking functionality for personal use, when the concept is very similar to the redistribution over the Internet (network), which flag prohibits sending protected content to even another device of your own for personal use.

The protection system includes combined technologies (approved and to be approved) that could have the potential of also restricting personal archival in D-VHS tape of a content already stored on a (fully) compliant digital HD-PVR (used for time-shifting purposes) if the content is flagged as copy-once. The system might consider the D-VHS taping as a second-generation copy, although the first generation in the PVR is not actually a permanent storage device copy for archival purposes.

Hopefully this would not happen if the technical implementation of the new system would be intelligent enough to allow D-VHS archiving while auto-erasing the source program stored on the PVR, so only one copy would exist.

Equipment purchased before the 'Broadcast-Flag' ruling becomes effective would not have the circuitry to react to the flag (*update made Feb 06*); that might set in motion a large number of purchases to occur before that date, but there is a risk for that equipment to end up having limited functionality when matted with compliant devices under the new protection technologies.

A flag-compliant DVD recording device might make a DVD recording that might not be playable on existing non-compliant DVD players, which could not decrypt the copy-protected signal. This could make an existing legacy DVD player limited from its original functionality, an issue that some groups indicate it could unfairly force consumers to buy new DVD players, although the FCC expressively states that "will not require consumers to purchase any new equipment".

It is also undefined how MVPDs, such as cable and satellite TV operators, who retransmit DTV over-the-air broadcasts, would actually be allowed/required to encrypt the digital content to maintain the flag's intent.

The FCC ruling gives them "the latitude to implement the flag as appropriate for their distribution platforms, whether it be through direct pass-through or by effectuating the flag's intent through their own conditional access system", for which the FCC "is seeking further comment from MVPDs" and also states "MVPDs may not assert greater redistribution control protection for digital broadcast content than that which the broadcaster has selected. In the case of content which a broadcaster has not marked with the flag, MVPDs must deliver that content to subscribers in a manner that reflects and gives effect to its unflagged status."

Some cable MVPDs were considering encrypting the entire basic tier to effectuate the flag's intent of the HD broadcast channels of the tier; imagine the implications to cable subscribers that currently do not use/need a separate STB for decrypting a basic tier (as with on-the-clear QAM cable tuners into integrated HDTVs).

When we have a better definition of the combined effect of the content protection technologies (with the ones to be proposed, courtesy of the MPAA), we might be able to confirm how the full extent of the content protection system would actually work with the mix of new and legacy devices. Although, in "spirit", the following was disclosed so far:

From the 'Plug-and-play' cable agreement: "Approval of New Connectors and Content Protection Technologies – The DFAST license anticipates FCC appellate oversight in cases of dispute over CableLabs determinations regarding the use of new connectors and content protection technologies".

From the 'Broadcast Flag' ruling: "… the FCC established an interim policy that allows proponents of a particular content protection or recording technology to certify to the FCC that such technology is an appropriate tool to give effect to the broadcast flag, subject to public notice and objection. The FCC's interim certification decisions will be guided by a series of objective criteria aimed at promoting innovation in content protection technology".

What Could You Do?

In addition to contact your representatives, the FCC, and your MVPD, to let them know that you want your HDTV investment and viewing/recording rights protected, there are several things you could do to make your transition to HDTV as safe as possible considering the circumstances.

Given that copy-protection of HD premium content, and prohibited digital redistribution of broadcast content, are both here to stay, to be on the safe side buy equipment that can handle DVI or HDMI digital connections. Make sure the digital connection is HDCP compliant, in addition to having the typical component analog connections (RGBHV, as 5 BNC or 15 pin D-sub VGA; or YPbPr wide-bandwidth 3 connectors, etc).

HDTVs that have more than one DVI/HDMI input would provide better flexibility to connect multiple HD components suited with such outputs (HD-STB, DVD player upconverting to HD, HD scaler, etc.). The insufficiency of DVI/HDMI inputs in TVs is starting to become a problem this year; one option is to install a DVI/HDMI switcher; make sure any equipment you buy that uses DVI or HDMI is HDCP compliant, including the switcher.

Buy HD tuning equipment also suited with IEEE1394 (FireWire) connections to facilitate HD networking and HD recording on D-VHS tape of content permitted to be copied (copy freely, copy once). IEEE1394 connections should also be present on an integrated HDTV that has a built-in HD tuner, make sure the connection is bi-directional, and not only a digital iLink input to connect digital camcorders.

Avoid buying an integrated HDTV set that does not have IEEE1394 to send the tuned signal out for HD recording, which also provides the choice to connect an external PVR (like the tuner-less RCA DVR10 $450) to time shift the program tuned by the integrated HDTV.

Regarding the availability of equipment suited with IEEE1394, the market offers the following:

a) Cable has been mandated to provide that connection by April 2004 when/if the customer requests an HD-STB suited with IEEE1394, try better leasing the box so the evolution on content protection technologies (and equipment failure) would not impact your pocket, just say 'send me another box', which also would facilitate the later DVI/HDMI upgrade from the MVPD for 2005, at their cost;

b) Some Over-the-air ATSC HD-STBs have IEEE1394; some also include an internal PVR for time shifting; some have also a QAM cable tuner;

c) Dish Network has IEEE1394 jacks on their recently introduced 921 PVR (although its activation was announced for later in the year); it also has an ATSC over the air tuner; JVC has a sibling of this unit; when 1394 is activated this unit will have all the connections, at $1,000. The IEEE1394 feature was never activated on either unit and both are discontinued now (*update made Feb 06*).

d) VOOM satellite will have IEEE1394 on their new Motorola 580 HD-STB expected for mid 2004; this is a PVR server centerpiece of a home-network with thin clients; the company 'might' offer an upgrade path for the owners of their original 550 model (which does not have, nor will be upgraded for, IEEE1394). The thin clients will also have IEEE1394, but being a network, the system of content protection (including the "Broadcast Flag") technologies might eventually impose limitations on distributing the digital signal. It is too early to know 'exactly' what would/not work, not because of VOOM; VOOM would have to implement the rules as they come. VOOM was sold to Dish Network early 2005, and the project of servers and clients is now subjected to Dish Network's hardware plans (*update made Feb 06*).

e) DirecTV has been avoiding the offering of IEEE1394 since DVI was introduced a few years ago; the new STBs announced for 2004 still omit such connection; however, if you already are a DirecTV subscriber, and HD tape recording is a requirement, you might want to opt for an aftermarket modification such as http://169time.com/, which would enable 'some' satellite HD-STBs by adding

IEEE1394 outputs (the modification costs more than the STB, but it might be worth for you).

As a DirecTV subscriber, if you just want to time shift HD content (no need for recording and networking), the newer DirecTV PVR/Tivo model HD-DVR250 from Hughes ($1,000), announced to become available April 2004, might be all you need. The unit is much less expensive now, and was announced that will be replaced by a MPEG-4 capable STB, but the time shift basis of this comment still applies (*update made Feb 06*).

In general, as with any first release model, especially HD-STBs, it is a good idea to research on Internet forums (i.e., www.avsforum.com) and reviews to make sure there are no serious problems with the unit of your interest. A good number of STBs from MVPDs receive gradual online firmware upgrades to correct reported problems, and improve the STB operation and performance, free.

There are other factors to consider:

1) Some people say, 'Buy nothing and wait'. I say, 'you have only one life, if you are ready and could afford the cost, the sooner you enjoy HD the better you and your family would feel'.

2) Other people say, 'Buy before the broadcast flag deadline so the equipment would not have the internal hw/sw design to read the flag. I say 'maybe'; I would not rush to buy for that reason if not ready; the rules and restrictions of the complete system are not 100% clear yet, the FCC is still working on wrapping some of them, like the analog hole down-res/new proposed technology. Since you still have over a year to make your decision, monitor the events to fit your purchase to the equipment choices that give you the best features according to your needs.

3) After six years of HD on the air the HD industry is still subjected to the powerful funding and lobbying of Hollywood (MPAA) pulling the strings by controlling content; our government seems to keep trying to be reasonable with everyone on the rulings, but there still a lack of a well organized plan with clear parameters for all to follow.

4) The rules and standards are gradually being introduced while the DTV train rolls on the tracks; some of those standards are replacing themselves on each stop of the trip (i.e., component analog/1394/DVI/HDMI, and DTCP/HDCP). It certainly feels as if the DTV train departed from the Union Station as an incomplete entity with some wheels that are square and wagons that are not well connected, but since the maintenance crew is tailoring and finishing the construction while rolling, we gained confidence that it will not derail, not by now.

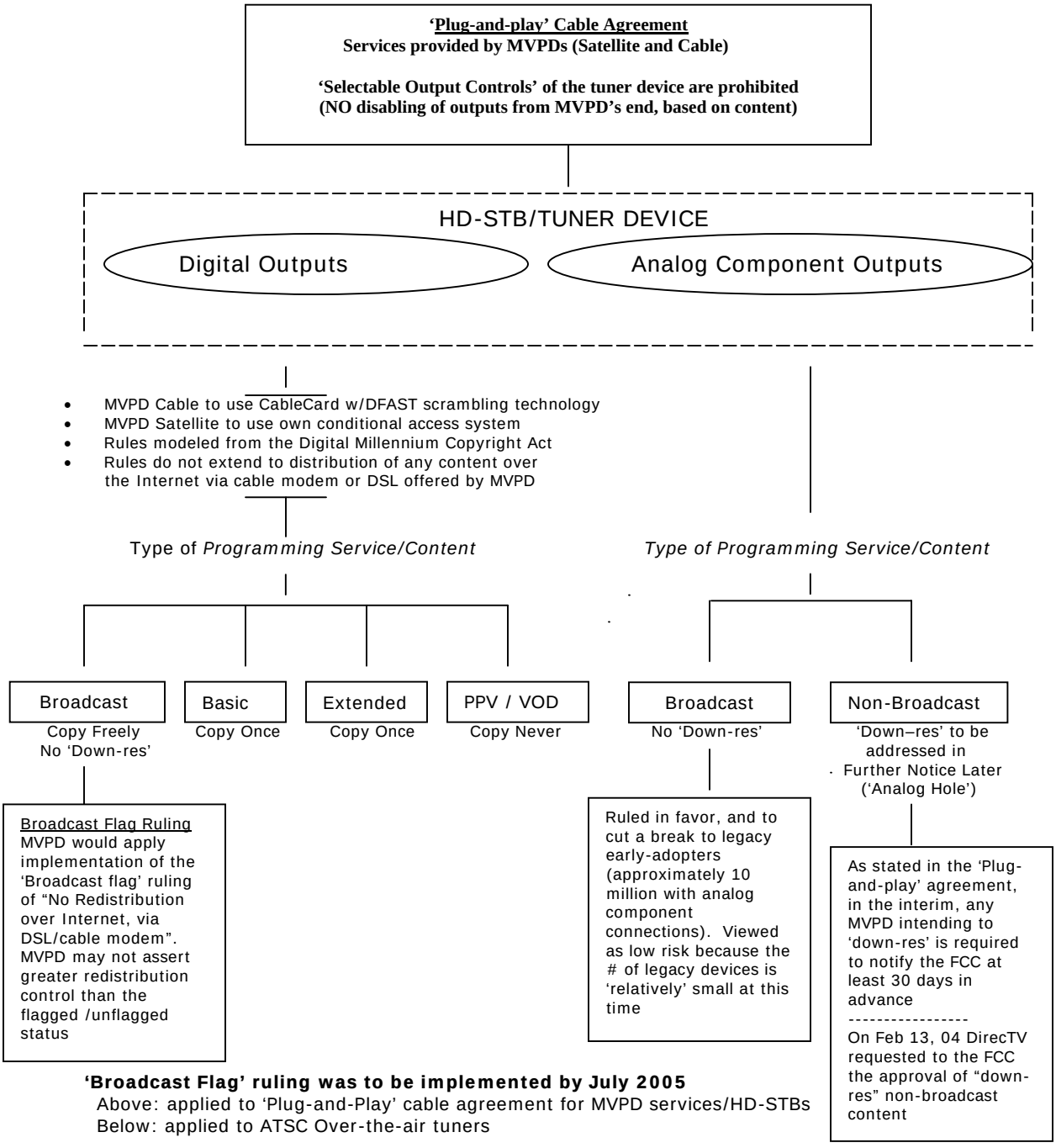
Another example of self-replacing/parallel HD standards is cable QAM tuners (on-the-clear/unidirectional/bi-directional), with no card/POD/now CableCARD, and the High Definition DVD format/Codec war (Blu-ray, HD-DVD, EVD, WM9, MPEG-2, MPEG-4, etc).

However, even when the DTV moving train has inefficient behavior, DTV had an unprecedented growth this year, and is certainly here to stay. Adopt HDTV with an intelligent purchase when ready to enjoy HD, not reacting to the pressure of implementation deadlines, standards, rulings, or the corner store inventory, neither

by waiting until the dust settles down. The dust never settles down in consumer electronics.

After seven years from introduction, HDTVs are now very affordable, and if you already have one, keep in mind that this technology upgrades itself so fast that by the time some issues are fully resolved, such as connectivity, recording, copy-protection, HD-DVD, etc., you might be tempted to replace it for a newer set with much better resolution, functionality, features, and technical capabilities, and hang it on the wall, at a very reasonable price.

Combined FCC Regulations Regarding Content Protection
'Plug-and-play' Cable Agreement and 'Broadcast Flag' Ruling



'Broadcast Flag' ruling was to be implemented by July 2005
Above: applied to 'Plug-and-Play' cable agreement for MVPD services/HD-STBs
Below: applied to ATSC Over-the-air tuners

Notes applicable only to ATSC Over-the-air broadcast tuners:

- To apply the chart above for Over-the-air (OTA) ATSC tuners only use the two 'broadcast' columns under digital and analog outputs.
- New content protection technologies are to be proposed to the FCC for approval in order to implement the 'Broadcast Flag' ruling, which prohibits Internet redistribution of content output from the digital connection (IEEE1394).
- No 'Down-res' (based on 'Plug-and-play' cable agreement regarding this type of content).
- Copy freely rule from IEEE1394 digital outputs (based on 'Plug-and-play' cable agreement).
- 'Analog hole' should not apply for this type of content (only concerns Non-Broadcast content).
- Selectable-Output-Control not applicable (only applicable to MVPDs in 'Plug-and-play' agreement.

HD Content Protection - Update

For a more complete background of the content protection subject for HDTV please refer to the dedicated section above “DTV Content Protection Copyrights rules and Agreements”, this section is dedicated to recent updates of those rulings and agreements.

AACS

The Advanced Access Content System was jointly developed by a group of companies including Intel, IBM, Disney, Microsoft, Warner Bros., Toshiba, Panasonic, and Sony for the High Definition DVD content protection.

AACS is capable to revoke a number of levels of devices that have been identified as problematic. The way Blu-ray extended the AACS protection implemented by the HD DVD format by integrating the following three components:

A) Advanced Access Content System (AACS), also used by HD DVD,
And two other specific to Blu-ray:
B) BD+ to provide content protection renewability, and
C) BD ROM Mark, to control against mass production piracy, mass duplication, and unauthorized copies of pre-recorded media.

The BD+ controls the playback on players that have been attacked by updating the security of the player that has been compromised. Players that have not been attacked but still vulnerable would not be affected by this control, in other words if one player of a model line has been attacked the system will disable that player not the entire model line.

The BD ROM Mark is an identifier in Pre-recorded BD-ROM movies produced by licensed BD-ROM manufacturers to disallow playback on unlicensed players. It helps control illegal disc replication, when the mark is read by a player before the disc will be allowed to play. The ROM Mark is unique per movie title, not per disc.

The BD Association (for Blu-ray) has agreed to now adopt the Mandatory Managed Copy (MMC) feature as a requirement on the format, supported by Microsoft and Intel for the copying of video, however, to avoid further launching delays of Blu-ray, the BD Association rejected the support to iHD as requested by HP, but declared that could be considered for later.

AACS Down-res Approved

In January, 06, the AACS Advanced Access Content System consortium, the organization responsible for content protection on the new Hi-def DVD formats, reached an agreement to require manufacturers of Blu-ray and HD DVD players to suit them with the ability to reduce the 1920x1080 resolution of protected HD video to one fourth the quality of the image stored in the disc (960x540) when played over component analog connections while responding to a digital flag present within the disc movie. The flag was named ICT, Image Constraint Token.

The digital outputs (HDMI or DVI) will still carry the full resolution of the disc because the outputs are protected by HDCP, while component analog connections cannot carry that protection, reason by which the resolution would be downgraded. The agreement affects approximately 10 million HDTVs sold since 1998 suited only with component analog inputs, and a large number of PC monitors/video cards used to watch Hi-def DVD that are not DVI/HDMI HDCP protected.

The studio is to supply the digital flag. If the studio sets the flag to "off" the player would supply full resolution to the analog outputs. The movie package must show if the flag was used on the movie to make the buyer aware upon the purchase.

Manufacturers of players and software (movies) would have to comply with the AACS ruling in order to obtain their license. Fox has not supported the idea; Disney, Paramount, and NBC Universal did support it; it was not confirmed if Sony would support it.

Please review additional details in the Analysis included with the Hi-def DVD section.

PVP-OPM

This content protection method is to be implemented in the new High Definition DVDs to prevent pirates from attaching recording devices directly to the PC graphics card's DVI or HDMI video outputs to gain access to a fully resolved unprotected image.

A PVP-UAB component has been planned to prevent the installation of data capture cards that would allow accessing the HD movie directly from the PCI Express bus; however PVP-UAB activation of HDCP would render many non-HDCP compliant PC monitors unable to display the image as HD, or at all.

For the VGA analog, the near future Vista operating system will reduce the resolution of the video but the video will be watchable at the level of quality of today's DVDs.

Vista is not alone in this feature. New consumer electronics devices that can play next-generation DVDs will also be incompatible with some monitors or TVs deemed insecure by studios.

Since neither XP security nor XP drivers support HDCP, a computer user would need to upgrade to the new Windows Vista operating system, and replace the monitor for an HDCP compliant unit.

Broadcast Flag

In May 2005, the federal appeals court in Washington rejected 3-0 the regulation of the Broadcast Flag implemented by the FCC, stating that the commission did not have authority to enforce such ruling, unless Congress enacted a law.

The MPAA lobbied Congress to work on it and expressed the following "The broadcast flag does not inhibit copying, nor does it prevent redistribution of programming over a personal home network--it only restricts unauthorized redistribution of programming over the Internet and other digital networks", while the Public

Knowledge group, said: "The broadcast flag legislation would give the Federal Communications Commission control over virtually any technology, from set-top boxes to computer software."

In September 2005, a group of twenty members of Congress (12 Republicans and 8 Democrats) requested the speedy approval of a federal law adopting the Broadcast Flag.

In November 2005, two legislation draft-proposals were prepared and were circulated on the House Judiciary Committee to give the FCC authority for the approval of Broadcast Flag regulations.

For more details about the Broadcast Flag subject, please refer to the section of “DTV Content Protection Rulings and Agreements”.

Additionally, there was a third proposal to prohibit the manufacturing, importing, or selling of any devices that would defeat the broadcast flag protection to output the converted signal on analog output connections (analog hole).

The patent and Trademark Office is now in charge of preparing the regulation for the Analog Hole.

Representatives form the MPAA, the RIAA, and the Public Knowledge organization, were invited to testify on the hearings about these legislations.

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 couple of years ago. Now, updated, is my contribution to the HDTV Magazine.

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 been 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 in the DVD and does not need of 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.

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 pass signals 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 overdriving the phosphors (in CRTs) in a way that edges of images appear to exceed their boundaries, because brightness or contrast might be too high, 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 to 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: 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 their loudness capacity would be exceeded much earlier than the external L/R speakers/amp (assuming that is larger than the TV audio, as typically is). The effect could be worst 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 yellowed 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 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: Directional Correctional De-interlacing. Faroudja's proprietary name for their de-interlacing chip used now in many products.

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 plus it keeps the signal in the digital domain.

DLP: DLP stands for Digital Light Processing. These 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 that technology were 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 hear from a specific area, it is the only thing that will be heard from that area. Dolby Digital is ported out of a DVD player of 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: Dolby Digital Plus is 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 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 capable of a higher-bit rate enhancement 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 2006 H/DTV Technology Review report for applicability and connectivity details.

Dolby is working closely with Silicon Image to ensure transmission of Dolby Digital Plus signals on HDMI v. 1.3. Those protocols and specifications were planned to be finalized on the 1H06.

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: 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 2006 H/DTV Technology Review report for applicability and connectivity details.

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.

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 along 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 an 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-HD (++, and Master Audio)

DTS announced that their new DTS++ (as named originally) 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 Mbps extension of the same format under a new name, DTS-HD Master Audio, 100% lossless and bit-for-bit identical to the studio master.

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 18Mbps.

The format was approved as optional for HD DVD and Blu-ray.

Check the Multi-channel Audio section of the 2006 H/DTV Technology Review report for applicability on Hi-def DVD formats and connectivity details.

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 consumer manufacturers implement compatible DTV tuners with the ability to receive/decode all the formats; 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).

Our current NTSC over-the-air (OTA) TV system is 480i analog (actually 525i with 480i visible lines). Digital satellite and digital cable are equivalent to digital SD but they are also transmitting some of their channels in HDTV. 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 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 are being 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.

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.

Under the five-year phased-in guidelines mandated by the FCC, over-the-air DTV tuners are 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.

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 are 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 is now found on most 2004 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.

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.

Faroudja 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.

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 for just using a non-1080p capable chip. 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 ¾ of the width of a 4:3 TV, 56% or 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 send/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 reduce 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.

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 not necessarily has 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: 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 and 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).

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 RGBS (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 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: 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 L(eft) 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 outs 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 20-20 KHz 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 them 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 they are installed. Consult your 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.

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 to 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.

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 shorten 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.

About the Author

Rodolfo La Maestra is the Senior Technical Director of the HDTV Magazine. Rodolfo participated in the HDTV vision since the late 1980's when HDTV was proposed as an analog system. In the late 1990's, he begun tracking and reviewing HDTV related technologies and hundreds of consumer products, which prompted him in 2002 to pioneer the authoring of the annual State of H/DTV Technology report, which encompasses all HDTV related equipment including Hi-def DVD, content providers, distribution systems (broadcast, cable, satellite), government, standards, connectivity, content protection, H/DTV tuners and DVRs, etc.

Rodolfo considers himself an educator, not a journalist, transferring knowledge, research, and experience. In addition to this annual publication, he has authored a variety tutorials and educative articles for HDTV Magazine, DVDetc, and HDTVetc Magazines, and served as technical consultant/editor for the "Reference Guide" and the "HDTV Glossary of Terms" for HDTVetc Magazine, included in this report and now available for HDTV Magazine readers.

In 2004, to help the public understand the H/DTV complexity, he began recording a TV technology periodical for Cable television that airs weekly. By 2006, the show has reached the rating of second most viewed by the public among all the technology episodes. The opening episode can be viewed in the HDTV Magazine Resources: http://www.hdtvmagazine.com/reference/tvshow_how-it-works.php

Rodolfo's background encompasses Electronic Engineering, Computer Science, and Audio and Video Electronics, over 4,000 hours of professional training, a BS in Computer and Information Systems, and over thirty professional and post-graduate diplomas, some from American, George Washington, and MIT Universities.

After 38 years of computer systems career Rodolfo retired in 2003 as Chief of Systems Development from the Inter-American Development Bank. He directed 65 computer professionals in the areas of information/transactional/web online systems, database administration, etc. supporting about 30 member countries 24/7.

In parallel, from 1998 he concentrated his personal efforts in helping the public with his other career of audio/video electronics. Rodolfo started with hi-end audio in the early 60's and merged with Home Theater video and multichannel audio technologies in the late 70's, such as the niche widescreen laser disc, anamorphic DVD, 16x9 NTSC displays, and HDTV.

When HDTV started airing in November 1998, he was an early adopter of the HDTV dream he followed since 80's but realized that the technology as implemented would overwhelm regular consumers due to its complexity, and it certainly does even today. Rodolfo then launched his HDTV mission of educating and helping consumers understand the complexity, the challenge, and the beauty of the technology, so the public learns to appreciate HDTV not just as another television.