Welcome to
an HD World!

White paper

06

Schneider Electric

Welcome to an HD World!
Contents

Presentation

Have you ever heard about HDTV?

What does it mean exactly?

What are the realities of this market?

How is LexCom Home Delta 8 currently handling the Digital TV transition and the move towards HDTV?

What are the technologies surrounding HDTV?

This document aims at giving you the key elements that will enable you to avoid the mis/dis-information that surrounds High Definition Television.

From DTV to HD

Starting in the 80's with the Compact Disc, digital technology and contents are now everywhere in our daily lives changing the way we communicate, do business, shop and even enjoy our leisure time.
The move towards Digital Television (DTV) is one step further in this evolution and should be considered as even more significant as the change from black-and-white to colour TV sets.

Former analogue TV sets providing snowy or ghostly pictures with only mono or stereo sound from a limited number of channels are becoming obsolete.
DTV, and going beyond HDTV, delivers on a 16:9 widescreen, a far better picture that is clear and sharp, combined with a Dolby Digital AC-3 sound and multiple audio tracks and video streams per channel capabilities.

Taking advantage of the continuous improvements in compression (MPEG-2, MPEG-4) and multiplexing, DTV will spread rapidly bringing more interactivity and new services (Video on Demand, time shifting, Electronic Program Guide, gaming, virtual entertainment etc…) in addition to better image quality.

As presented in detail later, DTV is made of two main formats - standard definition (SD) and high definition (HD), whatever the access network (Aerial, Cable, IP or Satellite TV).
HDTV is the most detailed and the best quality TV image you can have today.
At present, HDTV encompasses two main resolutions, which are 1280x720 pixels progressive scan (720p) or 1920x1080 pixels interlaced (1080i). Higher resolutions such as 1920x1080 pixels progressive scan (1080p) may be introduced in the future but are not currently in use. In addition to a higher resolution, HDTV would be the most suitable format to enjoy the Dolby Digital sound experience.

■ However, HDTV is still in its infancy. In Europe, most HD programs and services started in 2006 and are still limited in number or for some of them limited to specific events (Roland Garros, Football world Cup, etc.).
□ Premiere (Germany, Satellite, Dec. 2005)
□ Telewest / NTL (UK, Cable, Feb. 2006)
□ BSkyB HD (UK, Satellite, April 2006)
□ TPS (France, Satellite, Feb. 2006)
□ CanalSat (France, Satellite, 2006)
□ UPC (The Netherlands, Cable)
□ Orange TV (France, ADSL, 2006, HD option from TPS)
□ Free (France, ADSL, 2006, HD VOD content from Canalplay).

■ In addition to an appropriate transportation medium able to distribute HD signals with an optimum level of quality, HDTV requires three key and non dissociable elements along the transmission-reception TV value chain.
□ HD contents
□ HD Decoder
□ "HD Ready" TV set.

From production of HD contents through decoding and then displaying them on a "HD Ready" TV set, the investments both for the users or the professionals involved in the value chain are still heavy.

■ In addition to the cost and investment aspects other key issues have still to be addressed to ensure a rapid development of HDTV:
□ Creation of an HD content stock
□ Cohabitation of SD and HD contents
□ Security of Digital content / Digital Right Management (DRM), (see p.13)
□ High bandwidth requirement for HD contents transport (see p.16)
□ Interoperability and technical uncertainties (HDCP authentication, HDMI connectivity, Audio synchronization issues…), (see p.16-18).

Therefore unlike SDTV, the deployment of HDTV remains slow but is expected to grow rapidly from 2010 to 2015.

From DTV to HD (cont.)

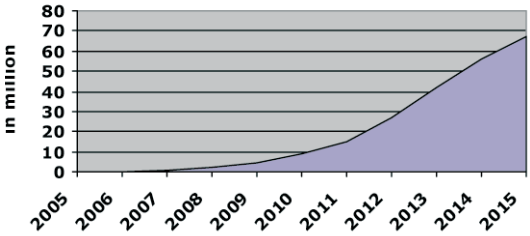

Figure 1: Forecasts of households equipped with HD decoders in Europe

The forecast of European households equipped with an HD decoder whatever the access network (DTT, DSL/broadband, Cable or Satellite) stands at around 65 million end 2015.

■ Without being exhaustive, we foresee for the coming 6 to 7 years the following main market drivers:

□ **The introduction of the "HD Ready" label on the TV sets** (see p.17):
- will create the necessary installed base for an HD contents request from the consumers.

□ **The introduction of the first HD-enabled DVD players & HD Game consoles** (see p.19):
- will allow consumers to enjoy HD contents without HDTV transportation issues and familiarise themselves with its High quality image.

□ **The "switch-over" from analogue TV to Digital transmission:**
- will solve the issue on the limited number of available channels to broadcast HD contents over DTT networks and will ease its mass market adoption.

Enjoy HDTV
with LexCom Home Delta 8

The **LexCom Home Delta 8** solution was initially created to answer the fast emerging demand for a smart and easy-to-use home network system able to simultaneously distribute Voice, Data & Image signals anywhere, anytime within the house.

Aside from Satellite signals which require specific coaxial cables and outlets to support frequencies up to 2,1 GHz coming from LNB, Delta 8 is able to handle both analogue and digital signals coming from all the following access networks:
- Aerial TV
- Cable TV
- Internet / Broadband.

Based on a 4 individually-shielded twisted pairs S/FTP copper backbone optimized to support frequencies up to 900MHz, Delta 8 now offers the most reliable and suitable infrastructure to enjoy the best of Analogue and Digital TV programmes, ensuring the highest level of quality in the distribution of HD contents throughout the house.

The following drawing presents the different ways to receive HD contents from a broadband or a broadcast network access as well as the distribution, decoding and displaying stages required to enjoy HD programs.

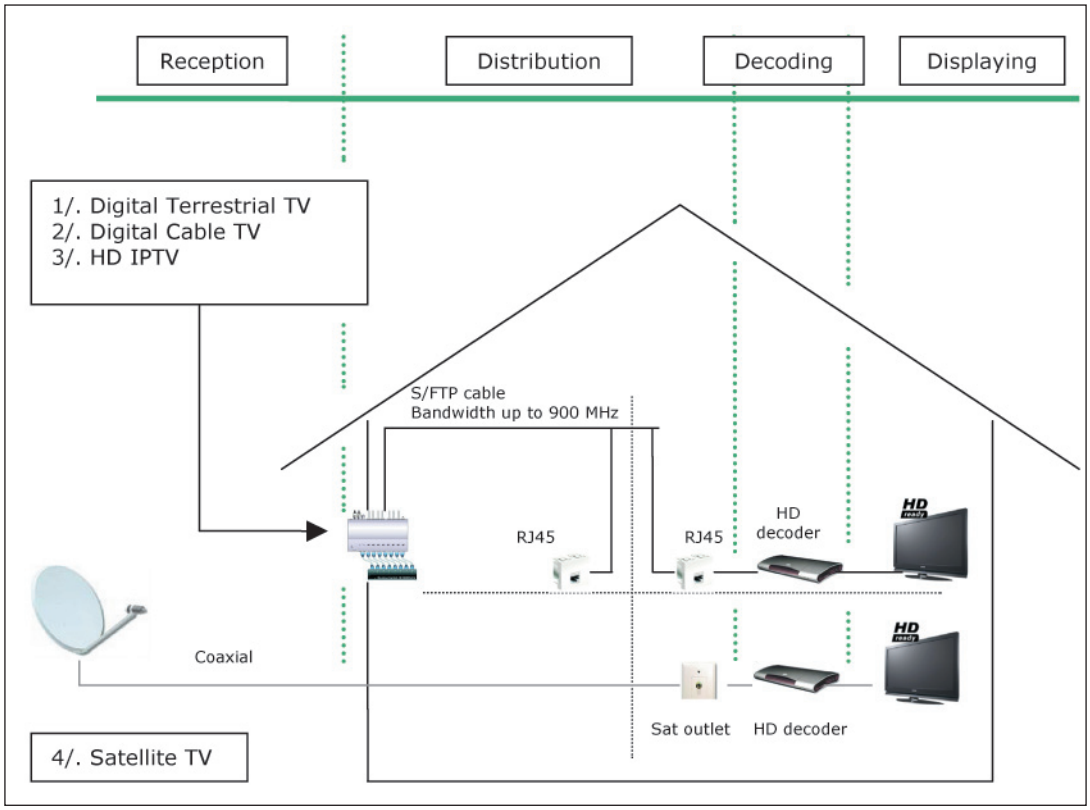

Figure 2: different ways of receiving HD content

Case 1&2: Digital Terrestrial (DTT) & Digital Cable TV

In accordance with the DVB standards –DVB-T for DTT and DVB-C for Cable TV, HD channels are broadcast within the 65-862MHz frequency range, which is the one currently used to broadcast Analogue and SDTV channels.
Thus HD programs are simply considered as additional channels within the VHF-UHF frequency range.
Since the Delta 8 network infrastructure can handle and distribute signals up to 900MHz, one can be ensured of fully enjoying HD contents from DTT or Cable TV when using the Delta 8 home network solution.

Enjoy HDTV with LexCom Home Delta 8 (cont.)

Case 3: Internet / Broadband

In the case of Internet TV or xDSL TV, the only difference between SD and HD programs stands in the required bandwidth/data rate that the home infrastructure has to support.
Thanks to its S/FTP copper backbone, the Delta 8 infrastructure copes easily with high bandwidth (up to 18Mbps) and the severe quality requirements for distributing HD signals.
The use of a 10/100Mbps Data switch combined with the Delta8 central unit makes it possible to have a 100Mbps data rate available at every RJ45 outlet in the home, enabling the transmission of several HD contents when available.

Case 4: Satellite

As stated earlier, the signal coming from the LNB of a satellite dish is in the 950MHz-2,1GHz frequency range and requires a specific coaxial cable infrastructure to be distributed to a specific DVB-S decoder.
This coaxial infrastructure is run in parallel with the Delta 8 home network without any interference.

HD contents will increasingly enter into our houses in the coming years and will definitely improve the way we watch TV programmes.
With this in mind, LexCom Home Delta 8 is already HD-friendly and Schneider Electric is moving forward to extend its capabilities to provide even more convenience, quality and comfort to users, offering them the best of the promising HD experience.

HDTV:
the technical story

Since 1937 and the invention of television, progress has been varied and spectacular. In order to explain and understand the technologies associated with the transmission, reception and display of HD programs, we have to go back some decades in time: to the 1960s and the launch of colour television….

Analogue television

In order to broadcast colour television, three standards appeared over the world:
- **NTSC**,
- **PAL** and,
- **SECAM**.

These standards are incompatible with each other but they implement the same principles.

For backward compatibility with the black and white TV, the colour information is translated into a luminance – chrominance encoding system. The luminance (also called Y component equivalents to level of grey) takes the place of the original monochrome signal and the chrominance (called U, V components) carries colour information.
Then these components are translated into a composite video signal that has the same bandwidth as the original grey-scale video signal; after that it is modulated.
The sound portion of a broadcast is modulated separately from the video.
At the end, the audio and video are combined at the transmitter before being presented to the antenna.

The differences are in the methods for composite video generation, colour and sound modulation, carrier frequency and channel bandwidth.
The resolution and sample rate are also different:
- **for NTSC 525 lines and 30 frames per second,**
- **for PAL and SECAM 625 lines and 25 frames per second.**

There are many variants of PAL, SECAM and NTSC standards.
The CCIR (International Telecommunications Union) has defined an identification scheme for broadcast television systems.
It is presented in the following table with the principal characteristics.

Table 1: world television systems

Systems	Lines	Frame rate (frames per second)	Channel bandwidth (MHz)	Sound modulation	Notes
A	405	25	5	AM	no longer used
B	625	25	7	FM	VHF only in most countries. VHF & UHF in Australia (see systems G and H)
C	625	25	7	AM	no longer used
D	625	25	8	FM	VHF only (see system K)
E	819	25	14	AM	no longer used
F	819	25	7	AM	no longer used
G	625	25	8	FM	UHF only (see system B)
H	625	25	8	FM	UHF only (see system B)
I	625	25	8	FM	UK, Ireland, South Africa & Hong Kong
J	625	29.97	6	FM	VHF, UHF in Japan
K	625	25	8	FM	UHF only (see system D)
L	625	25	8	AM	France: audio −6.5 MHz on VHF Band 1 only
M	525	29.97	6	FM	Americas, Taiwan, Philippines, South Korea (all NTSC-M), and Brazil (PAL-M)
N	625	25	6	FM	Argentina, Bolivia, Paraguay, Uruguay

HDTV: the technical story (cont.)

Figure 3 shows the repartition of these standards all over the world.

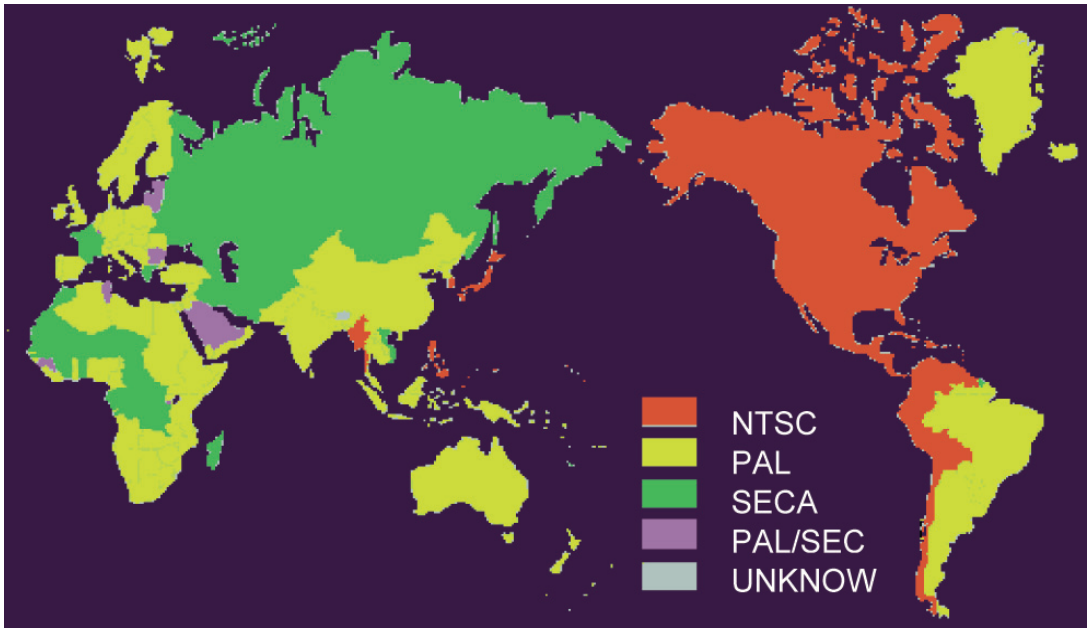

Figure 3: repartition of NTSC, PAL, SECAM standards in the world

Currently, analogue TV can be transmitted over-the-air, by satellite (which requires an additional frequency modulation step) or by cable.
For reception, TV sets include a tuner that enables reception of over-the-air transmission. For satellite and cable specific tuners are required.

Digital Television (DTV)

In the 1990s the introduction of Digital Television provided improved picture and sound quality, widescreen images, multiplexing of programs in one transmission channel, and the introduction of new digital services such as multiple audio streams for foreign languages, access control for subscription and pay per view, interactivity for video on demand. In order to obtain these great features, several technology standards are associated with the transmission and reception of DTV.
All of them are described below.

Analogue to digital

First of all, the sound and video (luminance and chrominance analogue signals) have to be converted into a digital format. The different steps of digitalisation are described in the CCIR Rec. 601 recommendation. It specifies the image format, acquisition semantic, the correspondence between the video signal levels and the quantization levels, and the way the digital signals are generated from the YUV analogue signals.

Format

In the case of digital television in the United States, DTV supports 18 different video formats defined by ATSC. They are divided into standard (SD) and high definition (HD) formats, interlaced or progressive, with aspect ratio equal to the wide-screen 16:9 or the standard width 4:3 format.
Table 2 summarizes the different formats.

Table 2: DTV formats defined by ATSC

Formats	Nb pixels per line x Nb lines	Interlaced progressive	Frame Rate (frames/second)	Aspect Ratio
12 SD formats	640 x 480	i	30	4:3
	640 x 480	p	24, 30, 60	4:3
	704 x 480	i	30	4:3
	704 x 480	i	30	16:9
	704 x 480	p	24, 30, 60	4:3
	704 x 480	p	24, 30, 60	16:9
6 HD formats	1280 x 720	p	24, 30, 60	16:9
	1920 x 1080	i	30	16:9
	1920 x 1080	p	24, 30	16:9

■ The **SD formats** encompass 12 different versions in 4:3 aspect ratio and in 16:9 aspect ratio with different frame rates.

■ **HD** encompasses 6 video formats, including 1920x1080 in interlaced mode (abbreviated 1080i), 1920x1080 in progressive mode (1080p) and the 1280x720 pixels in progressive mode (720p). All of them have wide-screen, 16:9 aspect ratios with several frame rates.

■ In Europe, DTV formats are roughly the same except that the frame rate is 25 frames per second (against 30 for ATSC).

In order to visualize the improvement of frame size between SD and HD, figure 4 shows the different formats, it does not accurately reflect the aspect ratio of SD formats, which is always stretched or squeezed to 4:3 or 16:9.

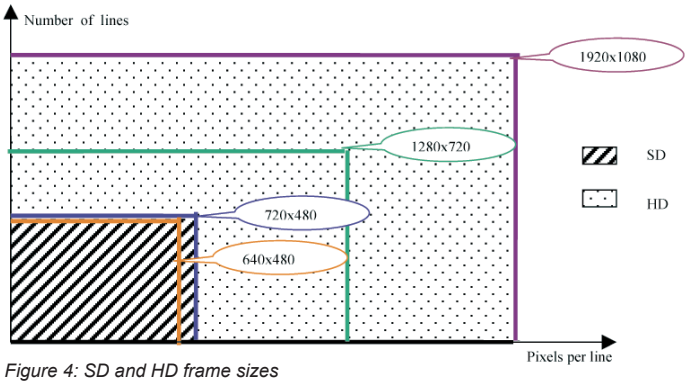

Figure 4: SD and HD frame sizes

HDTV: the technical story (cont.)

Compression

After digitalisation, data is compressed thanks to the MPEG standard, using as few bits as possible. Currently, **MPEG-2** is the most known and used standard for digital compression of audio and video signals. It was established in 1994.

The principle is to convert digital audio and video signals to packets of compressed digital data called bit streams that are more efficiently transported over a network.

The video compression method is based on the removing of redundant information from video signals.

■ Two kinds of redundancy can be identified:
□ Spatial and temporal redundancy: pixel values are not independent, but are correlated to their neighbours both within the same frame and across frames.
In this way the pixel value is predictable given the value of neighbouring pixels.
□ Psycho visual redundancy: the human eye has a limited sensitivity to fine spatial detail so the controlled impairment introduced by the bit rate reduction process should not be visible to a human observer.

■ Two techniques use these properties:
□ discrete cosines transform (DCT) and,
□ motion compensation prediction.

With these technologies, it is possible to reduce the transmission rate (called bandwidth) to 2–4 Mbps (Mega bits per second) against more than 100 Mbps for a non compressed SD frame.
The audio coder can compress the audio part to a few hundred kilobits per second. Depending on the performance of the encoding and decoding equipment and the compression rate, the bandwidth can double for the same image. Obviously the value of the bandwidth also has an influence on the quality of the decoded image.

Digital Rights Management (DRM)

In the case of a subscription service, video and audio content has to be protected against copying or pirating. **All technologies used to control access to digital data (such as software, music, movies) are called Digital Rights Management.** The principle of these techniques is that the content is scrambled using a ciphering algorithm and a "key". The viewer needs the key to descramble the content. The transfer of the key between the transmitter and receiver can be done by many ways.

In the video broadcasting domain, MPEG has not defined a method of scrambling - it has defined what can be scrambled and how access control data may be transmitted in an MPEG stream. So several companies propose their own scrambling solutions, there are some examples:

Table 3: video scrambling system (DRM)

System name	Company	Example of use
Mediaguard	Originally SECA (Societe Europeene de Contrôle d'Accès) partnership between Canal Plus & Bertelsmann,now mainly belonging to Thomson	Canal Plus/CanalSatellite group channels, German Premiere bouquet
Viaccess	France Telecom	TPS (Television Par Satellite), AB-Sat
Irdeto	Design by Nethold before being repurchase by Canal+, now developed by Mindport	Kirch/DF1, Nethold/Multichoice, Telepiu, M-Net
Nagravision	Nagra-Kudelski	Spanish Via Digital multiplex
Conax	Telenor	Canal Plus for Scandinavian packages
Cryptoworks	Philips	Canal Plus for Scandinavian packages
BetaCrypt	BetaResearch (Kirch company)	Overtaking Irdeto for Premiere World
VideoGuard	NewsCorp	Sky Digital in UK
PowerVu	Scientific Atlanta	Professional transmissions, Retevision, Bloomberg, Discovery, AFRTS

Transmission

MPEG-2 is also associated to standards defining the way compressed digital data is transmitted.

■ **There are three main digital broadcasting systems:**
□ **ATSC** developed by the Advanced Television System Committee,
□ **DVB** for Digital Video Broadcast developed by the European Broadcasting Union,
□ and **ISDB** in Japan.
These standards define the physical layer and data link layer of a distribution system.

■ For terrestrial systems (Digital Terrestrial TV, DTT), ATSC is adopted as a standard in the United States and Canada, ISDB-T in Japan and the DVB–T in most of the rest of the world.

■ The DVB-S standard specifies the broadcast satellite services in Europe; it is also used in USA. For cable television, there are DVB-C standard and 64/256-QAM used in USA.

Depending on the medium specificities and standards, different methods of modulation are used. The modulation and error protection parameters can be adjusted for all standards to ensure optimized use of bandwidth capacities and respect of the quality targeted by the network operator or program provider. Table 4 gives the main features for the different media and standards.

HDTV: the technical story (cont.)

Table 4: ATSC - DVB - ISDB specifications

	ATSC	DVB	ISDB
Video compression			
	MPEG-2		
Audio compression			
	Dolby digital	Dolby digitalMPEG	Dolby digital
Channel bandwidth (MHz)			
	6	6 ,7 ,8	5.6 compatible 6 MHz
Support HDTV format			
	yes	yes	yes
Terrestrial			
Modulation	8-VSB or 16-VBS	COFDM, QPSK, 16QAM and 64QAM	BST-OFDM (segmented structure OFDM)
Frequency range	VHF/UHF	VHF/UHF	VHF/UHF, super high band
Bandwidth /channel	up to 19.4 Mbps	up to 31.67 Mbps	19 Mbps
Cable			
Modulation	16-VSB	QAM	-
Frequency range (MHz)	-	downlink: 70 – 862 uplink: 5 – 65	-
Bandwidth/channel	-	up to 38.1 Mbps	-
Satellite			
Modulation	QPSK, 16 QAM	QPSK	-
Frequency range (GHz)	10.95 – 12.75	10.95 – 12.75	-
Bandwidth/ channel	up to 38.8 Mbps	up to 38.8 Mbps	-

■ **IPTV covers both live TV and stored video (Video on Demand VoD)**, it delivers television programmes to households via a broadband connection using Internet protocols.
The copper wires that are used to carry telephone calls are also capable of transmitting data (internet content). This extra bandwidth in the copper wire is normally wasted, but technologies such as ADSL, ADSL2+, and VDSL enable us to take advantage of the available bandwidth to transfer data at a higher frequency than that used for voice calls.
Unfortunately, there is a drawback: the higher the frequency is, the faster the signal will degrade over distance. Then the available bandwidth between the service provider and the household (called the "last-mile bandwidth") depends on the distance and the technologies used by the service provider.

□ **ADSL** (asymmetrical digital subscriber line) technology can support last-mile bandwidths between 512 Kbps and 8 Mbps.

□ **ADLS2+** provides a bandwidth up to 25 Mbps, with a maximum distance of 1.4 kilometres.

□ **VDSL** (very-high digital subscriber line), a new technology with some experiments underway, will enable to speeds of up to 52 Mbps, but over shorter distances than ADSL - 1.3 km at 13 Mbps and 0.3 km at 52 Mbps.

Knowing that an SD frame requires around 4Mbitps (refer to Figure 6 for more details), it is easy to understand that the development of TV over ADSL is roughly tied to the deployment of very-high bandwidth networks: ADSL2+ and VDSL for copper line infrastructure and fibre to the home.

Reception

Digital signals can be received by standard aerial, satellite dish, coaxial cable or via phone outlet (for IPTV) but have to be decoded and turned back into sound and pictures by using a separate box (called Set Top Box, STB).

The STB demodulates the signal of the particular channel to be viewed.
In the case of a subscription service, the receiver decrypts the program stream using a description key that is stored in the STB or on a smart card that is inserted into the STB. Then the receiver decodes the MPEG video and audio bit stream and the TV set displays the program.

Figure 5 illustrates the global system which enables the transmission and reception of DTV program whatever the media:

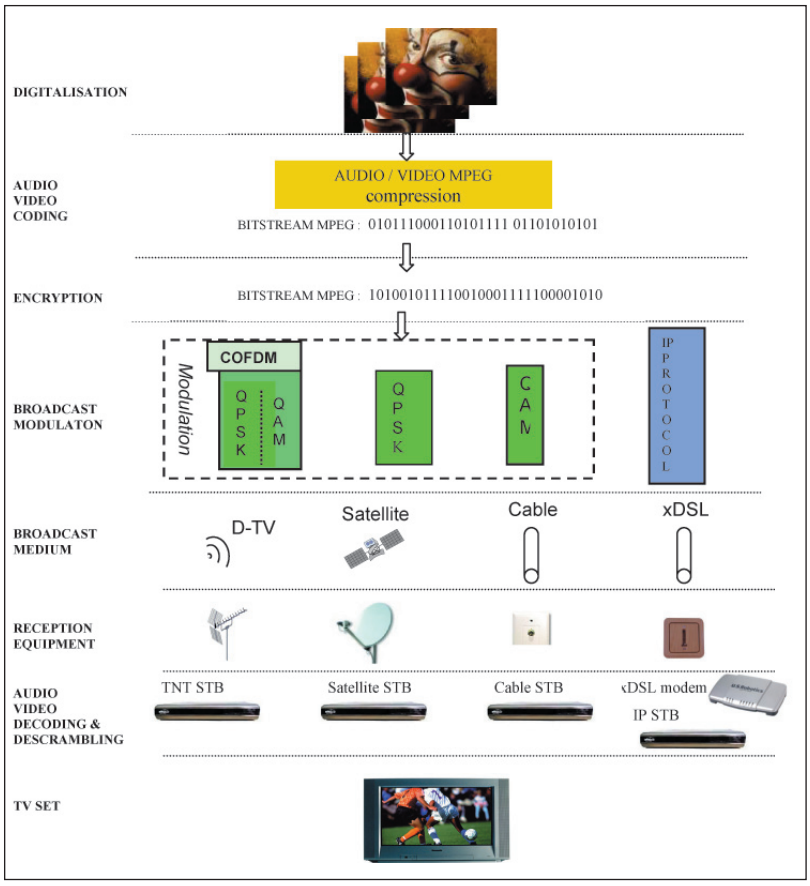

Figure 5: DTV system

HDTV: the technical story (cont.)

What is HDTV?

High Definition Television is defined as any ATSC resolution with 720 or more lines: thus the 6 highest resolution formats defined in the Table 2 are considered as HDTV.
HDTV offers better resolution, up to five times more pixels in a frame, than analogue or standard formats. It also offers improved sound quality with surround sound.

The frame size being larger, the required bandwidth to transmit the encoded signal is also higher. Currently, **MPEG-2** is the most commonly used in the compression codec for digital HDTV.
The development of advanced coding is essential to reduce the bandwidth but it increases the Set Top Box cost for the customer and the broadcaster has to invest in new expensive encoding equipment. One suitable standard is the **MPEG-4 part10** (H.264-AVC), it decreases the required throughput by about 30% to 50% without loss of quality. There is another suitable codec, **Microsoft Windows Media (WM9)** which has roughly the same performance as MPEG-4 part10.
The following figure shows the typical bandwidth requirement for SDTV and HDTV depending on the compression standard.

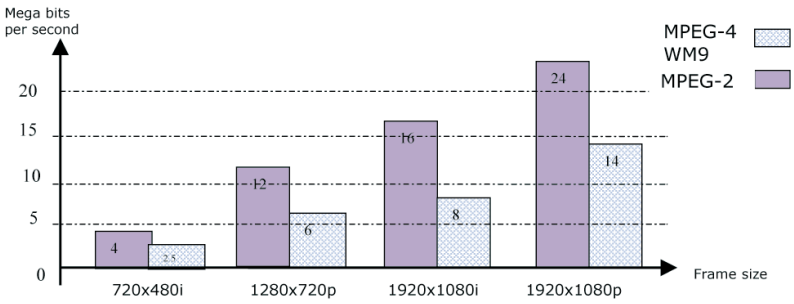

Figure 6: MPEG-2, MPEG-4 & WM9 bandwidth requirement for DTV formats

All transmission media (cable, satellite or terrestrial) and broadcasting standards (DVB, ATSC) can deal with data stream carried HD content with MPEG-2.
With MPEG-2, the HD transmission rate is around 16 Mbps. However one transmission channel can only broadcast about 1 or 2 HD programs instead of 4 or 6 SD programs (refer to the Table 4 for the bandwidth per channel depending on the medium). With the deployment of new compression standards, it will be possible to transmit more HDTV programs in one transmission channel.

For this deployment, it is important that the H.264-AVC and WM9 compressed data can be mapped into the structure of MPEG-2 bit streams. This enables consistent saving, keeping a part of the broadcasting infrastructure used for MPEG-2.
The DVB and ATSC standards work on this aspect.

For satellite broadcasting, even if the DVB-S enables the transmission of HD programmes, a new specification of DVB-S has been deployed since November 2005. DVB-S2 includes new carrier modulation schemes and a method of adaptive coding, which provide about 33% more data rate than the DVB-S standard. Currently on the 46 HDTV channels available by satellite in Europe, there are 8 HD programs transmitted in MPEG-2 and DVB-S, 38 in MPEG-4 including 23 with DVB-S2 and 15 with DVB-S.

How does HDTV work?

Like SDTV except that …
HDTV reception requires an HD video source from satellite, cable, terrestrial or broadband connection coupled to a Set Top Box capable of decoding audio and video encoded streams. The STB has to be connected to a "full HD" or "HD ready" TV set. The "full HD" or "HD ready" labels indicate that the TV set is capable of supporting HD formats.

HD labels

■ The **"HD ready"** logo, launched by the Industry Association for Information Systems, Communication Technologies and Consumer Electronics (EICTA) in January 2005, is introduced as a quality sign for the differentiation of display equipment, capable of processing and displaying high definition signals, awarded on the basis of minimum functionality requirements.

Requirements for HD Ready include:
□ The minimum native resolution of the display (e.g. LCD, PDP) or display engine (e.g. DLP) is 720 physical lines in wide aspect ratio.
□ The display device accepts HD input via: Analogue YPbPr and DVI or HDMI.
□ HD capable inputs accept the following HD video formats: 1280x720 @ 50 and 60Hz progressive ("720p"), and 1920x1080 @ 50 and 60Hz interlaced ("1080i").
□ DVI or HDMI input supports content protection (HDCP).

■ A **"FULL HD"** TV set has a minimal native resolution equal to 1920x1080 pixels in interlaced mode (1080i). It is able to display this format "directly". On the other hand the "HD ready" TV set has to adapt the 1080i frame to fit 1280x720 resolution.

■ There is another **"HDTV" logo** created in October 2005 by EICTA concerning reception equipment.
The application of the logo to reception devices will guarantee consumers that the device is capable of delivering a genuine HD signal over a compatible interface to an "HD ready" display device. The specification applies to free-to-air and PayTV HD television receivers. The specification requirements cover fully integrated HD digital TVs, HDTV receivers without a display that can be connected to "HD ready" display devices and HD television receivers with recording capability.

HDTV: the technical story (cont.)

HDMI and DVI interfaces

In order to connect the different HD equipment items together, two interfaces were developed:

■ **The High-Definition Multimedia Interface** (HDMI) is an industry-supported uncompressed, all-digital interface for interconnecting any compatible digital/video source, such as STB, DVD player and compatible HDTV set. It is able to carry both uncompressed HD video and uncompressed multi-channel audio in all HD formats including 720p, 1080i and 1080p.
□ There are two 2 types of connectors:
- the Type A connector carries all required HDMI signals up to 4.9 gigabits per second. It has 19 pins,
- the Type B connector is slightly larger and is designed to support resolutions higher than 1080p. It has 29 pins and is not yet in common use.

HDMI technology has been designed to use standard copper cable construction at long lengths. In order to allow cable manufacturers to improve their products through the use of new technologies, HDMI specifies the required performance of a cable but does not specify a maximum cable length. Cable manufacturers are expected to sell reasonably priced copper cables at lengths of up to 15 meters.

The Figure 7 presents the different types of connectors.

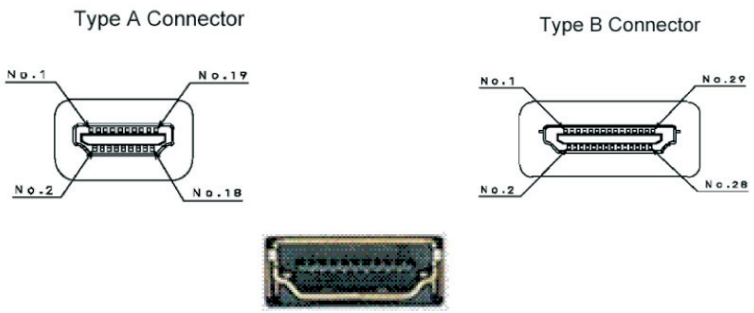

Figure 7: HDMI connectors

■ **Digital Video Interface (DVI)** is a video interface standard designed to maximize the visual quality of digital display devices such as TV sets, computer display and digital projectors. It was developed by an industry consortium, the Digital Display Working Group (DDWG).

□ There are three kinds of connectors:
- the DVI-A, capable of transmitting only analogue signals, it is not used for HD,
- the DVI-D, which has 24 pins, is capable of handling only digital signals,
- the DVI-I, with 29 pins, handles digital and analogue signals (24 and 5 pins respectively).

□ DVI-I and DVI-D can be used in two modes:
- Dual Link using only 12 pins or,
- Single Link implementation using 24 pins.
The two modes support HD format up to 1080p resolution.

The Figure 8 shows the different connectors.

Figure 8: DVI connectors

Table 5 sums up the characteristics of the different connectors:

Table 5: HDMI - DVI connectors

Parameters	HDMI Type A	HDMI Type B	DVI-I	DVI-D
DTV format	up to 1080p	higher than 1080p	up to 1080p	up to 1080p
Audio connection	yes	yes	no	no
HDCP support	yes	yes	yes	yes
Number of pins	19	29	29	24
"max" cable's length (meters)	15	15	5	5

HDCP

High Bandwidth Digital Content Protection is a DRM (Digital Right Management) technique. This key system was developed by Intel to prevent video data from being pirated. HDCP was strongly endorsed by the entertainment industry.
If a source device is HDCP coded and is connected to a HDTV display or projector via DVI or HDMI without the proper HDCP decoding mechanism, the picture is relegated to "snow" or in some cases, a very low (480P) resolution.
In order to see HDTV with HDCP compliance, both the source and display devices must be equipped with DVI/HDMI connections that can enable HDCP using "software key" decoding. HDMI and DVI connections support HDCP.

DVD and the HD

At this time, a classical DVD has a capacity of 4.7 Gigabyte (single-layer) and could store about two hours of an SD movie (at a rough average rate of 5 Mbps: 4 Mbps for video and 1 Mbps for two or three audio tracks).

The next generation of DVD was developed to enable recording, rewriting and playback of HDTV. In 2006, the first pre-recorded digital optical HDTV media has been introduced.

There are two competing standards Blu-ray Disc and HD DVD that are incompatible with each other.

■ **The Blu-ray Disc format** was developed by the Blu-ray Disc Association (BDA), it is supported on the hardware side by Hitachi, LG, Matsushita (Panasonic), Pioneer, Philips, Samsung, Sharp, Sony, HP, Dell, Apple, TDK, and Thomson. Sony announced that it plans to incorporate a Blu-ray drive into its PlayStation3 games console in July 2006. Samsung should introduce their Blu-ray players in June 2006.

The Blu-ray Disc format was developed to enable recording, rewriting and playback of high-definition video (HD), as well as storing large amounts of data.
The format offers more than five times the storage capacity of traditional DVDs and can hold up to 25 Gigabytes on a single-layer disc and 50 Gigabytes on a dual-layer disc. It is equivalent to 9 hours of HD video (at an average rate of 13Mbps) or about 23 hours of SD video on a 50GB disc.

■ **The HD DVD format** was developed by the DVD Forum, the consortium behind the previous DVD standard. HD-DVD is supported on the hardware side by Toshiba, NEC, Sanyo, and Thomson.
HD DVD discs will hold 15 Gigabytes on a single-layer disc and up to 30 Gigabytes on Dual-layer disc. This format is supported by Microsoft, which will announce an add-on HD DVD drive for their Xbox 360 game consoles.

Blu-ray Disc and HD DVD support several codec MPEG-2, MPEG-4, SMPTE VC-1. Both standards also offer content protection technology.

On the other hand, the studios have been divided between the two formats.
Fox, New Line, Paramount and Warner have announced that they will release titles on both formats. Others, such as Buena Vista, Lio Gate, MGM and Sony will support Blu-ray disc only. Universal have currently announced they will support just HD-DVD. Currently, few movies can be purchased on the market; the offer should grow in the coming months.

HDTV: the technical story (cont.)

This technical fight over DTV and HDTV shows that different technologies, standards and actors are present at each step of the transmission-reception chain.
In the compression domain, the MPEG-2 standard is well-known and mature even if the compression rates are not satisfactory for HD broadcasting.
New technologies such as H264-AVC or WM9 are more efficient but their deployment has just begun and several years will be necessary to fix all the technical issues, to adapt the infrastructures and to replace old STB.
The main technical issues to solve are ability to guarantee backward compatibility between standards, and the possibility to multiplex the transmission of programs compressed in the different standards.

The expansion of HDTV will drive the development of new interfaces to connect HDTV sets, STBs… as well as new storage supports (HD DVD, Blu-ray) to record HD movies.

Thus many standards coexist today without a clear leader on the market making customer choice a complicated matter!

Although several labels have been introduced to help customers, interoperability improvements are still expected to ensure "HD labelled" equipments will all work together.

Glossary

A

Amplitude Modulation (AM)
see FM.

Aspect ratio
Screen width as compared to its height.
For example, a "32-inch TV screen" would be 25.5 inches wide and 19 inches tall.
There are 4x3: traditional TV aspect ratio or 16x9: "widescreen" TV aspect ratio.

ATSC
Advanced Television Systems Committee is the group that developed the digital television standard for the United States.

AVC
Advanced Video Codec that significantly reduces the bandwidth requirements.

C

CCIR Rec. 601
It is the old name of a standard published by the CCIR (now ITU-R BT.601) for encoding interlaced analogue video signals in digital form.

COFDM
Coded Orthogonal Frequency Division Multiplexing modulation used for terrestrial broadcasting.

D

Dolby Digital
See Surround sound.

DRM
Digital right Management.

DTT
Digital Terrestrial Television.

DVB
■ DVB-C: ETSI EN 300429 V1.2.1 (1998-04):
"Digital Video Broadcasting; framing structure, channel coding and modulation for Cable systems";
■ DVB-S: ETSI EN 300 421 V1.1.2 (1997-08):
"Digital Video Broadcasting; framing structure, channel coding and modulation for 11/12 GHz Satellite services";
■ DVB-S2: ETSI EN 302 307 V1.1.1 (2005-03):
"Digital Video Broadcasting; Second generation framing structure, channel coding and modulation for broadcasting, interactive services, new gathering and other broadband Satellite applications";
■ DVB-T: ETSI EN 300 744 V1.5.1 (2004-11):
"Digital Video Broadcasting; framing structure, channel coding and modulation for digital Terrestrial television".

F

Frequency modulation (FM)
It is a form of modulation which represents information as variations in the instantaneous frequency of a carrier wave. Contrast this with amplitude modulation (AM), in which the amplitude of the carrier is varied, while its frequency remains constant.

H

HDCP
High Bandwidth Digital Content Protection.

I

Interlaced scan
A way to scan vertical lines onto a TV picture by scanning all the odd lines first, then filling in the even lines (this happens almost instantaneously). The NTSC system uses 525 scanning lines to create a frame: the frame is made of two fields: the first field has 262.5 odd lines (1, 3, 5 …) and the second field has 262.5 even lines.
The odd lines are scanned in 1/60th of a second and the even lines follow in the next 1/60th of a second. This presents an entire frame of 525 lines in 1/30th of a second.
For a PAL system it is the same thing except that there are 625 lines at with a frame rate equals to 25 images per second.

ISDB
Integrated Services Digital Broadcasting standard, mainly used in Japan and for terrestrial broadcasting.

Glossary (cont.)

L

LNB
Low Noise Block converter.

M

MPEG
Moving Picture Expert Group.

N

NTSC
National Television Standards Committee in the USA responsible for developing standards for analogue standard TV.

P

PAL
Phase Alternation Line - a signal format used in video equipment in Europe and parts of Asia.

Pixel
Term used for "picture element", the smallest elements in a television picture. The total number of pixels limits the detail that can be seen on a television.

Progressive scan
A way to scan vertical lines onto a TV picture by scanning all the lines consecutively.

Q

QAM
Quadrature Amplitude Modulation used for cable broadcasting.

QPSK
Quadrature Phase Shift Keying modulation used for satellite transmission.

S

SECAM
"Système Electronique Couleur Avec Mémoire" is a signal format used in video equipment in France.

SMPTE VC-1
Microsoft's Windows Media 9 (WM9) codec for HD.
It offers roughly the same performance as H264-AVC.

Surround sound or Dolby Digital (formerly Dolby AC-3)
The audio standard for ATSC digital television, using approximately 13:1 compression.
Six discrete audio channels are used: Left, Centre, Right, Left Rear (or side) Surround, Right Rear (or side) Surround, and a subwoofer (considered the ".1" as it is limited in bandwidth).
The bit rate can range from 56 kbps to 640 kbps, typically 64 kbps mono, 192 kbps two-channel, 320 kbps 35mm Cinema 5.1, 384 kbps Laserdisc/DVD 5.1 and ATSC, 448 kbps 5.1.

Switch over
Governments of the European Union, Japan, and the United States are officially committed to replacing conventional television broadcasting with digital television in the first few years of the 21st century.

U

Ultra High Frequency (UHF)
It designates a range (band) of electromagnetic waves whose frequency is between 300 MHz and 3.0 GHz. UHF is the most common frequency bands for television.

V

Very High Frequency (VHF)
It designates a range (band) of electromagnetic waves whose frequency is between 30 MHz and 300 MHz. Common uses for VHF are FM radio broadcast at 88–108 MHz and TV broadcast.

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