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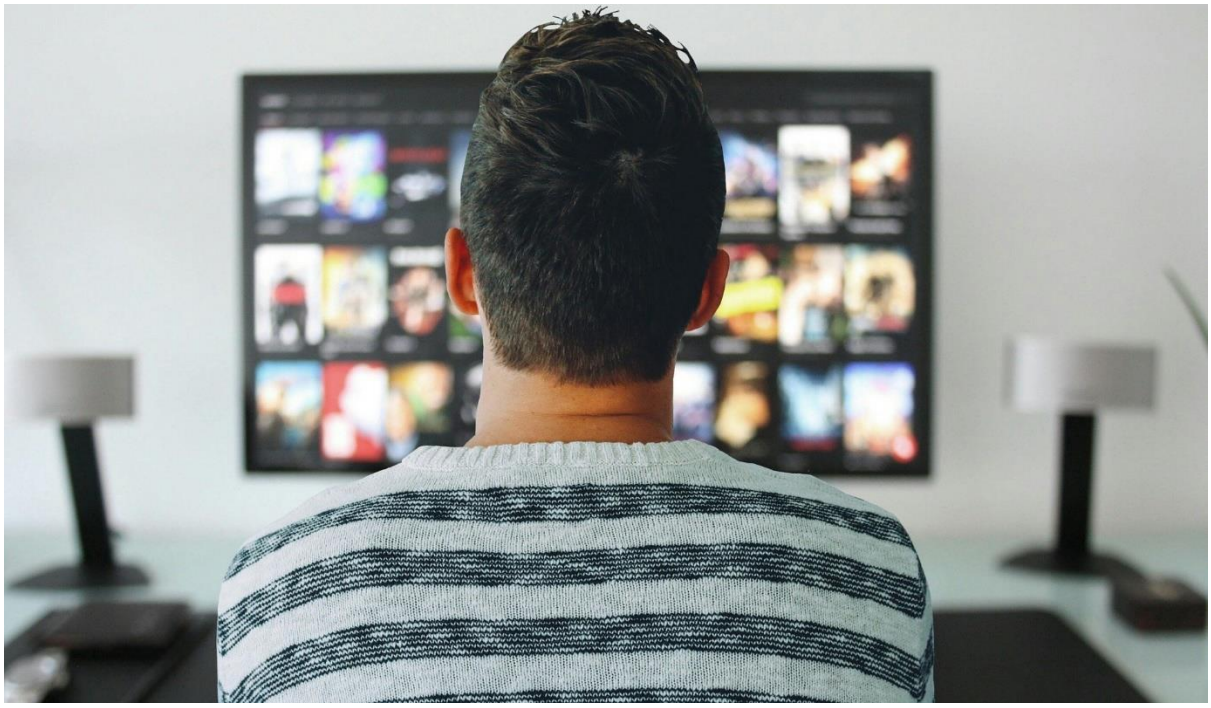
White Paper



Preparing for HDTV

What to look for in the move towards HDTV

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1. Preparing for HDTV: An Introduction

Although HDTV has been technically possible for more than 20 years it is only now that it has become commercially viable. This has been due mainly to the availability and cost-effectiveness of flat panel displays coupled with the new compression techniques of MPEG 4 and VC-1, which allow for high quality HD pictures at bit rates around 8 - 12 Mbit/s

Ever since the invention of television we have been trying to increase the quality of the pictures. From 405 lines to 625 and colour! However with the advent of large flat panel displays these resolutions are stretched to the native resolution of the display and any flaws are magnified.

HDTV gives us TV pictures with the potential for about 4 times as much detail as standard definition. Subjectively the picture quality increases from 'fairly good' to 'excellent' and being delivered digitally means a clean and solid picture.

HDTV is upon us! HDTV is already being transmitted, there are HD DVDs and camcorders and with the forthcoming services from Sky next year we need to prepare.

But beware, not all things are the same – there are many proposed standards of HDTV and displays, so quality will vary depending on their ability to display the correct resolution.

2. Preparing for HDTV: What is HDTV?

There are two common HDTV formats in use today, usually referred to as 1080i and 720p. The numbers refer to the number of horizontal lines in each frame of video. So in a 1080i signal, there are 1080 lines per frame of video, and in a 720p signal there are 720 lines per frame.

The 'i' and 'p' indicate whether the signal is interlaced or progressive. In an interlaced signal, all of the even numbered lines are transmitted in one batch, followed by all of the odd numbered lines. Interlacing is a method of reducing the bandwidth necessary to transmit a signal (and thereby increasing the number of channels) whilst keeping the perceived higher resolution, (current PAL television is 625i). So with the interlaced 1080i signal, only 540 lines are recorded by the camera and transmitted at a time; they are then reassembled at the time of display.

In a progressive signal, all lines of the frame are transmitted at once in sequence. So, with 720p, all 720 lines are recorded and transmitted in sequence.

Given an aspect ratio of 16:9 there will be (1080 x 16/9) 1920 horizontal pixels for a 1080i signal, giving a resolution of 1920x1080. Similarly for a 720p signal there will be (720 x 16/9) 1280 pixels, giving a resolution of 1280x720. This format works well in the current climate as a lot of flat panel displays are progressive devices and 768 lines in resolution.

Care must be taken when choosing a display as those with a lower native resolution will need to compress the signal so that it can be displayed. However, help is at hand as the Consumer Electronics Association has specified that any HDTV (which include a decoder) or HDTV monitor (HDTV ready) will have active vertical scanning lines of 720 progressive (720p), 1080 interlaced (1080i) or higher. So look for the badge!

3. Preparing for HDTV: Where Does HDMI Fit In?

HDMI The cable and connector of choice is the High-Definition Multi-media Interface (HDMI), an industry supported, uncompressed, all-digital audio/video interface. HDMI provides an interface between any compatible digital audio/video source, such as a set-top box, DVD player, and A/V receiver and a compatible digital audio and/or video monitor, such as a digital television (DTV).

Figure 1 – HDMI connector

HDMI supports standard, enhanced, or high-definition video, plus multi-channel digital audio on a single cable. This video data is then encoded into Transition Minimized Differential Signalling or TMDS, for transmission digitally over HDMI. TMDS incorporates an advanced coding algorithm which has reduced electromagnetic interference over copper cables and enables robust clock recovering at the receiver to achieve high skew tolerance for driving longer cable lengths as well as shorter low-cost cables.

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 metres. As semiconductor technology improves, even longer stretches can be reached with fibre optic cables, and with active cable technologies such as amplifiers or repeaters.

HDMI also includes support for 8-channel uncompressed digital audio, the DDC channel (for communication with the display) and the Consumer Electronic Control (CEC) channel (the standard AV Link protocol).

3.1 Connector Detail

Type A HDMI is backward compatible with the single-link Digital Visual Interface (DVI) used on modern computer monitors and graphics cards. This means that a DVI source can drive an HDMI

monitor, or vice versa, by means of a suitable adapter or cable, but the audio and remote control features of HDMI will not be available. Additionally, without support for HDCP, the video quality and resolution may be downgraded by the player unit.

Connector example: Molex 500254-1907

Type A Connector Pin Assignment

Pin	Signal Assignment	Pin	Signal Assignment
1	TMDS Data2+	2	TMDS Data2 Shield
3	TMDS Data2–	4	TMDS Data1+
5	TMDS Data1 Shield	6	TMDS Data1–
7	TMDS Data0+	8	TMDS Data0 Shield
9	TMDS Data0–	10	TMDS Clock+
11	TMDS Clock Shield 1	12	TMDS Clock–
13	CEC	14	Reserved (N.C. on device)
15	SCL	16	SDA
17	DDC/CEC Ground	18	+5V Power
19	Hot Plug Detect		

4. Preparing for HDTV: HDCP

HDCP High-bandwidth Digital Content Protection (HDCP) has been developed to prevent copying of the digital HDTV signal. The movie studios were so paranoid that anyone could make perfect copies on a mass scale they invented a method of protecting the digital signal. However, they spent so much time developing it that manufactures started producing equipment with digital outputs and inputs using DVI connectors without HDCP. This has created a real problem for backward compatibility!

HDCP works by the video source inserting 'keys' into the digital video signal. These 'keys' are used by both the source device and display to calculate a value. This value is then compared and, if equal, the video image is then displayed correctly. This method requires both the source and display to communicate together; this is achieved by using the DDC connection.

The problem comes when the display in not HDCP compliant. In this situation the quality of the image is 'down-graded' to a lower resolution or a snowy picture as shown below.

Figure 2 – Non-HDCP compliant monitor

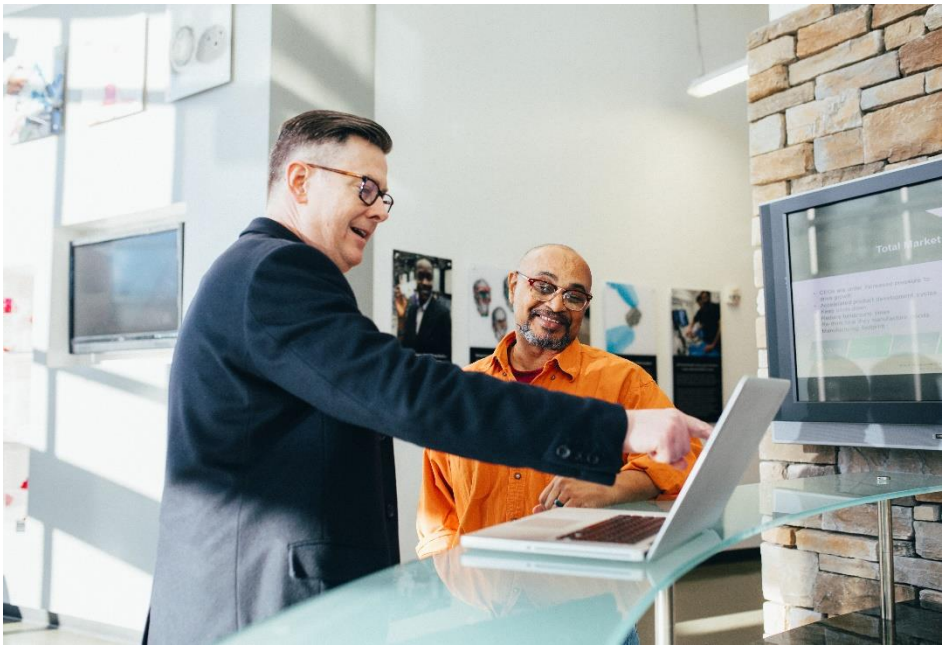
5. Preparing for HDTV: System Consideration

Connectivity for digital HD will therefore be via either DVI or HDMI depending on the age of the display. HDMI is the easiest connection requiring only one cable between the source and display as it also carries the audio channels and control features. Cable lengths up to 15m are now available at reasonable prices. Connecting via DVI will require more than 1 cable if you need audio, and cable lengths are restricted to 5m.

The transmission of digital signals over cable works very differently to analogue signals. With analogue the signal gradually degrades as the cable length increases, so you still get a picture but it becomes softer. Digital signals are prone to the 'cliff effect' whereby the image is suddenly lost when the errors become too great. This is not particularly helpful for fault finding!

Although HDMI has an improved cable length over DVI it still restricts the maximum distance between source and display. For a multi-room video distribution system the cable length will need to be dramatically increased. It is early days but equipment manufacturers are trying to catch up with the technology and there are some interface products around. A popular method of distributing signals is via Cat 5 structured cabling which is easy to install and cheap. There are some DVI and HDMI Cat 5 extenders on the market able to transmit the signals up to 50m however, make sure that they support HDCP!

There are also distribution amplifiers and some clever interface boxes like the HDFURY X3 from HDFURY, which can adapt non-HDCP displays to HDCP sources, such as converting HDMI to VGA/YUV. [1] The input is HDCP compatible and can accept HDMI input signals from 480i to 1080p.



6. Preparing for HDTV: Analogue HDTV

Until now we have been discussing the issues of digital HDTV. However, most of these problems are eliminated if we connect using the analogue HD signals. The analogue outputs of most HD devices will replicate the resolutions of the digital outputs i.e. 720p and 1080i so you will still get the same

[1] https://www.hdfury.com/product/hd-fury-x3/

clarity. Connectivity is normally via the standard VGA HD15 connector or the high-resolution Component output using 3 x RCAs.

Using the analogue HDTV removes the HDCP problem as this is not present on the analogue outputs. It therefore removes the problem of backward compatibility of older displays not being HDCP compliant. The analogue HD signal can then be distributed over standard Cat 5 cable for several hundred metres. A suitable solution for distribution of HDTV throughout a building is the SmartNet X product from Smart-e.[2] The product can not only handle all the HDTV formats but also any analogue video. This allows you to mix and match the HD with standard Component, Y/C, RGBS and even VGA signals up to 1600x1200 resolutions. It is also fully controllable via infrared and serial connections.

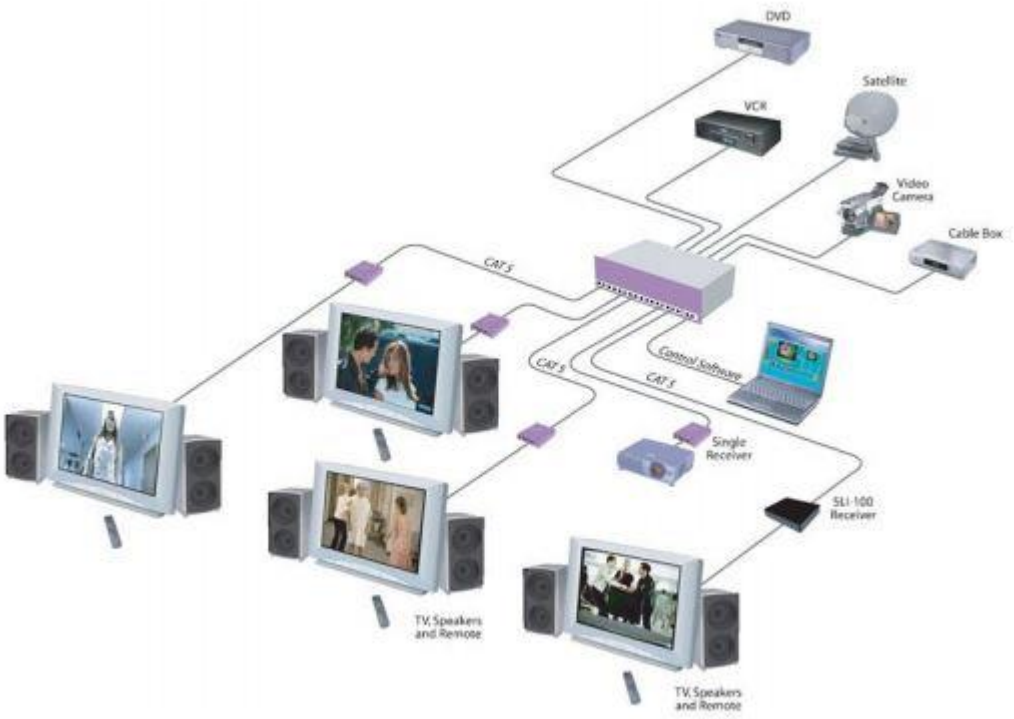


Figure 3 – SmartNet X distribution system

7. Preparing for HDTV: In Conclusion

We all need to prepare for HDTV since Sky will start transmitting HD content in 2006 with sports and movies. Once this happens the take-up of HD will increase so it is important to consider the impact now. Make sure that all displays you buy now are 'HD Ready' this will ensure that there is a HDMI connection and will accept 720p or 1080i signals.

Although HDMI is the standard connection method for HDTV you will also find DVI and analogue connection available but be careful as older displays might not be HDCP compliant.

If you want to future-proof a multi-room installation then consider installing a Cat 5 infrastructure. There are many manufacturers of video and audio distribution system using Cat 5 and any future developments will certainly use Cat 5 cable.

[2] http://www.smart-e.co.uk/product-categories/smartnet

8. About Smart-e

A UK company with over 25 years' experience in the Broadcast and AV industry, Smart-e are at the forefront of visual and audio technology.

Our technical expertise and working partnership with several universities means we are able to design and develop the most comprehensive and innovative product range for AV switching and distribution solutions over CAT 5-8 cable.

Our extensive client portfolio ranges from smaller companies wanting a one-to-one presentation solution to blue chip clients and distributors worldwide. Our adaptable products offer solutions to customer requirements from high end residences, banks, educational environments and hotels to super yachts, multi-national corporations and more. We pride ourselves in being global pioneers in AV distribution.

For more information please contact us at: www.smart-e.co.uk.

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