A Beginners Guide to HD Video

Formats, Specs and Types for Shooting, Editing and Watching

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*From:* <http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-0>

**The HD Specification**  
So what is [HD](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704)? Hi-definition video is more than just a name to indicate an image has higher resolution than previous video forms, rather HD is a specific technical specification that all major hardware manufacturers and [software developers](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704) have agreed upon for the future of film, TV, video and broadcasting.

The HD specification dictates a number of areas of the HD format but most particularly and importantly it specifies the frame size and dimensions of the [image](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704). Existing Standard Definition (SD) has fixed dimensions of 720 pixels wide x 576 pixels high for PAL and 720x480 for NTSC. The HD spec allows for two different HD frame sizes; a smaller 1280x720 and a larger 1920x1080… the larger of these being nearly ~~three~~ four times the size of SD.

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| http://images.digitalmedianet.com/2007/Week_15/gkb8j5kd/story/sdhd%20frames%20copy.jpg |
| SD/HD frames |

These two size specs are commonly referred to as 720 and 1080 and of the two, the later, larger frame is quickly becoming the dominant standard for both HD TVs and for camera shooting formats. There is another factor to the two frame size specifications; **progressive** **scan** and **interlaced** images. HD 1280x720 is a progressive scan image and this is often indicated by the use of a p next to the 720 (720p). A progressive scan image is one where each frame is composed of a single, solid picture. 1920x1080, by contrast, is, most often, an interlaced image (referred to as 1080i) whereby the image is made up of two interlaced fields at half second intervals which together make up the full frame rate. There is much debate over which type of image looks better but the distinction is marginal. The overwhelming majority of HD equipment manufacturers; from cameras, to [software](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704), to TVs, are focused on 1080. Also all TV display devices can scale very effectively to accommodate both so there are few issues regardless of which format you work in. The grail of course is 1080p which has the best of both worlds both large frame and progressive.

This all sounds fine and dandy; HD is a much bigger picture and a much sharper image. There is of course a catch however and thats the sheer amount of data a HD [video](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704) file takes up and how much bandwidth it requires to be viewed without stuttering. Uncompressed HD at full 1920x1080 is just too monstrously huge to be captured, handled or even played back by anything but the most powerful, professional production systems. So, in order to make HD viable and efficient it needs to be compressed.

**HD Compression**  
There are currently two major compressed HD video formats for consumers and prosumers widely available in a variety of [cameras](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704), from the very cheap to the relatively expensive. The first is HDV and the second, and newest, is AVCHD.

**HDV**  
Short, obviously, for [High Definition](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704) Video, HDV was introduced in 2004 and offered the first viable HD format available in inexpensive cameras. In order to make the HD format more manageable, HDV applies two very important and clever processes to the signal to reduce its size without overly reducing [image quality](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704).



The first of these is a stretching of the image known as anamorphic stretching. Anamorphic images are nothing new and have been common in cinema since the 1950s, using curved lenses to squeeze a wider image onto a narrow frame of film. The HD spec defines the HD image as 1920 pixels wide. In this case the pixels are square and equally wide as they are high. The HDV format doesnt record 1920 square pixels but rather records 1440 rectangular pixels with each pixel having a Pixel Aspect Ratio (PAR) of 1.333:1 (where each pixel is 1.333 times wider than it is high). This allows for an image visually the same width as 1920 but recorded with fewer actual pixels and thus reducing the amount of data required.

The second process is in the compression of the video data itself. HDV uses the MPEG-2 codec (Compressor/DECompressor) which is the same type of compression used in DVDs and digital broadcast signals. Video is a frame-based medium where by individual frames are shown so quickly your eye is fooled into seeing a singular moving image. MPEG-2 compresses the visual information by organizing these frames into groups known as a Group Of Pictures (GOP). In this way HDV doesnt record all the individual frames but instead a complete frame and then a group of partial frames that refer back to that whole frame. By this grouping the amount of data required for the HD signal is again greatly reduced.

One of the downsides of MPEG-2 compression is that when editing the footage the video files have to be unpacked and the frames rebuilt on the fly by the editing software as you work. This makes HDV editing very system intensive and requires relatively powerful computers to work efficiently. That said with dual-core [computer](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704) CPUs now the standard any machine bought now or in the past year or two should be more than capable of editing HDV.

**AVCHD**  
Short for Advanced Video Codec High Definition, AVCHD is the newest HD format to be released for inexpensive HD video production. Where HDV cameras tend to more expensive and professional in features, AVCHD is intended to become the new standard for HD camcorders for everyday home movie use.



AVCHD employs the same anamorphic stretching of HDV but specifically uses the H.264 codec which is able to greatly compress a video signal whilst still retaining a large degree of quality. Roughly speaking a H.264 is able to compress to half the size of Mpeg2 and yet still look visibly as good.

As a result of this compression AVCHD files are remarkably small in file size by comparison to even HDV without sacrificing too much in quality. The downside of AVCHD is that the very large amount of compression means the computer has to work very hard to unpack the files to edit them. Moreover, since AVCHD is a brand new format there is as yet no editing software available that can read or work with AVCHD files. Thats said all major developers have announced they will support AVCHD in coming versions of their software and so we will soon see AVCHD in common use.

**Recording Formats and Media**  
As [video](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1) has changed and evolved so to has the types of media and formats video signals can be recorded to. Not so long ago there was no choice beyond digital tape; now there are three main popular forms of camera types recording [HD](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1) Tape, DVD and Hard Drive.

**HDV TAPE**  
Tape cameras still make up the majority of both consumer and professional video [cameras](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1), but this is changing rapidly. Whilst tape is still the preferred choice for more professional cameras (and still has some significant advantages over non-tape formats), consumer cameras are very[quickly](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1) leaving tape behind in favor of non-linear DVD and hard drive-based offerings.

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| http://images.digitalmedianet.com/2007/Week_15/gkb8j5kd/story/hdv_digitalmaster.jpg |
| HDV digital master |

HDV uses only tape-based cameras utilising the small MiniDV cassette tapes - the same as used for Standard Definition DV. Footage is captured in real-time to your [computer](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1) system via FireWire, same as DV.

HDV tape has a number of advantages, most notably the robustness of the format. HDV tape has the longest shelf life and is the most resistant to damage. If you chew or damage part of a tape you can [simply](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1) spool past it and still retain the rest of the footage. If you scratch a DVD you can lose everything..!! HDV is also the least compressed of the popular compressed HD formats and so is technically the highest quality.

The main disadvantage of tape is that it is a linear format and so capture happens in real-time (1 hour of footage takes 1 hour to capture). This can make it a more time and process intensive format to work with than non-linear formats.

**Recordable DVD**  
DVD camcorders have been around for some time for Standard Definition recording and AVCHD makes them viable for HD recording as well. Standard Definition DVD cameras, whilst very efficient, were very much inferior in quality to MiniDV and were primarily designed specifically for those users who did not want to edit or post-produce their footage but simply to shoot and watch straight away in a DVD player. AVCHD produces a much better [image](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1) with higher quality compression and so, once software support for the format arrives sometime in 2007, AVCHD DVD camcorders such as the [Sony](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1) UX1 will be a much more viable HD format for shooting and editing.

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| http://images.digitalmedianet.com/2007/Week_15/gkb8j5kd/story/dvd.jpg |
| DVD camcorders are currently limited to about 30 minutes per disc recording. |

The big advantage of DVD is that it is non-linear, meaning that individual shots can be viewed and accessed in the [camera](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1) before transferring to computer and, similarly the files can be shifted from the DVD to the computer selectively rather than having to capture all in real-time. DVD[camcorders](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-1) transfer footage via USB cable and so long as the USB port on your computer is USB 2.0 the files will move very quickly.

The main disadvantages of DVD is that recording times are restricted to between about 15-25 minutes per disc depending on the quality setting chosen in the camera. These cameras can generally also accept dual-layer discs which can double the recording time.

The other main disadvantage is that DVD was never designed as a long-term storage medium or to be very robust. DVDs are effectively dissolving and degrading from the moment they are made and a simple scratch can render a disc unusable. You should never leave your only copy of important video on DVD.

**Hard drive**  
The last of the three popular camera types is the Hard Disc Drive camera. These work by writing video data directly to a small internal hard disc mounted inside the camera. This offers all the non-linear advantages of DVD but Hard Drive cameras tend to be faster to read and write data because hard drives spin faster than DVD discs. Hard Drives can also hold a much greater amount of data up to 30GB on some models meaning hours and hours of footage can be captured before needing to transfer to computer.

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| http://images.digitalmedianet.com/2007/Week_15/gkb8j5kd/story/hdr-sr1_grip_lg.jpg |
| Sony's HDR SR1 records to a hard disk drive. |

The disadvantage of hard drive cameras is that they too are quite fragile, one drop and you may well lose all the footage on the hard drive in one go. There is also no removable media to take out of the camera and store so you need a computer wherever you go if you plan to shoot a lot you cant just swap hard drives like you can swap tapes or DVD discs.

Hard drive cameras, like DVD, connect via USB and the computer will simply see your camera as an external hard drive whereby you can copy over your footage shot by shot or all at once.

**Delivering and Watching HD**  
Of course all this shooting and editing HD [video](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-2) is all well and good but what about watching it and delivering it to an audience? At the moment the major HD video delivery mechanism that all are expecting is still on the horizon taking its time to find its way into popular domestic use. There are two competing formats for DVD-like disc delivery of HD material; Blu-Ray and HD-DVD. Developed and supported by different [developers](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-2) and manufacturers, it is still unclear as to which one will ultimately become the dominant standard much like the old VHS vs Betamax format wars of the 1980s. Only time will tell.

HD-DVD uses existing red-laser [technology](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-2) which is the same as normal DVD's and so relatively cheaper to produce and more easily backwards compatible than Blu-Ray. Blu-ray however has the support of the major Hollywood studios and so potentially will attract consumers by offering first the movies they really want. In the meantime however, until you cough up the cash for a Blu-Ray burner or HD-DVD authoring system, there are still a number of ways you can watch your HD videos in their native HD resolution on a HDTV or [computer](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-2) screen.

**Component Video**  
Many of the new HDV and AVCHD cameras have a component video output socket that provides an individual plug for Red, Green and Blue color signal. Most HDTV sets will similarly have Component Video input sockets. With this set-up you can directly connect your camera to your HDTV and watch your video in its native [HD](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-2) resolution. Component video cables however only carry visual signal so you will separately need to connect audio from the cameras AV socket or headphone output to the audio input of your HDTV.

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| http://images.digitalmedianet.com/2007/Week_15/gkb8j5kd/story/component-video-cable-2.jpg |
| Component video cable |

If you have shot on HDV to tape and captured and edited your video in a computer editing system, then you can perform a Print To Tape (PTT) which involves writing the completed video back out via FireWire to a blank tape in the camera. The final product can then be played back out from the tape via Component Video connections to the HDTV.

If you shot on AVCHD, DVD or Hard Drive then you dont have the option to print back to the camera but can watch the raw HD video directly from the camera via Component cables. In the near [future](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-2) it is likely that there will be stand-alone Blu-Ray or HD-DVD players that are also AVCHD compatible and able to play back the native AVCHD disc.

**HDMI**  
Short for [High Definition](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-2) Media Interface, HDMI is an alternative to Component connections with the advantage that the three plugs are merged into a single easy to use plug. HDMI also trumps Component because the single cable also carries the audio signal as well as the video. So one plug is all you need to connect up your HDV or AVCHD camera so long as your camera and HDTV have HDMI connections.



**WMV-HD**  
For finished and edited projects that need to be more portable and transferable, Windows Media Video (WMV) offers support for HD images and playback. WMV is a file format and compression scheme that most video editing systems can render to. WMV compresses the video substantially so some quality is lost but the overall file size is massively reduced and the resulting [image](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-2) is generally very good. WMV-HD is also able to house 5.1 surround sound audio.

**MP4 FILES**

The other digital file format that can accommodate HD resolutions is \*.mp4 files using the AVC codec (the same as is used to encode data in AVCHD cameras). Most good video editing systems can render and export in \*.mp4 format at HD resolution, and like WMV, the data can be heavily compressed to make the otherwise massive HD video files much more manageable and portable.

Both these computer-based formats can be played back on a computer and if the [computers](http://tvs.consumerelectronicsnet.com/articles/viewarticle.jsp?id=127704-2) monitor supports HD resolutions, can subsequently be seen in their native HD. Similarly your computer or laptop can be connected to your HDTV to playback these HD files. This is simply a case of connecting the computer to the HDTV via either a VGA connection or, preferably, a DVI connector cable (depending on what input options your HDTV has).

**CONCLUSION**

The shift to HD from traditional standard definition is happening extremely quickly and all sections of the market are at the mercy of corporate directions, technological changes and a steep learning curve. This is especially true of consumers and amateur video makers where there is a large degree of confusion and misinformation in the market place. But becoming familiar with the terminology and formats is well worth the effort. Once you've seen the glory of HD you never go back.