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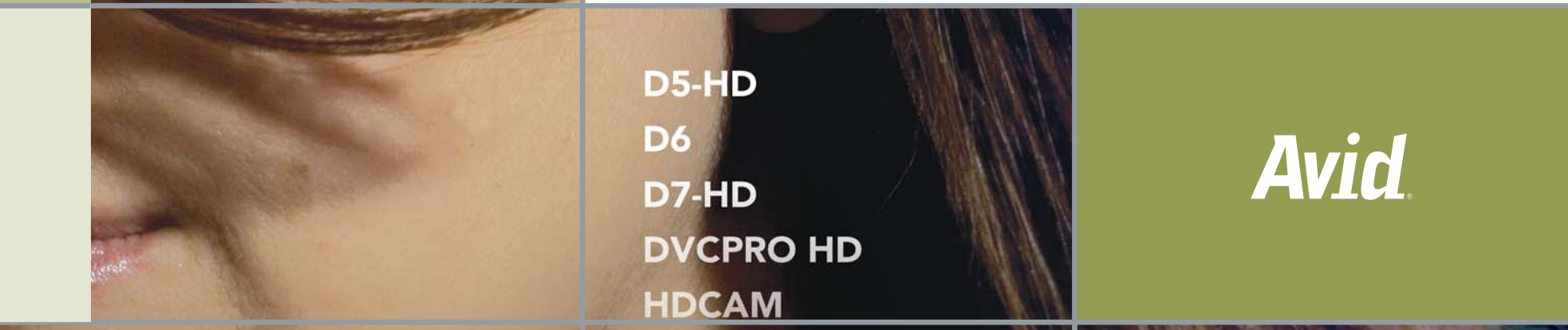
Chapter 4

HD formats



Avid

Tape formats for high definition television now span a wide range of qualities and prices. These cater for the recording needs of digital cinematography, mainstream broadcast and programming and, most recently, the prosumer market. The latter is addressed by HDV and has enabled a huge expansion of HD use.

D5-HD

This is an HD version of the D5 half-inch digital VTR format from Panasonic and has been widely used for HD mastering. It records on a standard D-5 cassette shell for over two hours with a wide selection of video formats: 1080/60I, 1035/60I, 1080/24P, 720/60P, 1080/50I, 1080/25P and 480/60I. It can slew a 24Hz recording to use the material directly in 25/50Hz applications – useful for European replay of movies. There are eight discrete channels of 24-bit 48kHz digital audio to allow for 5.1 and stereo mixes.

Panasonic uses a proprietary compression scheme to reduce the raw HD-SDI 4:2:2 component digital video data rate of up to 1240Mb/s. The D5-HD compresses video 4:1 (8-bit mode) and 5:1 (10-bit mode).

WWW http://www.panasonic.com

Also see HD VCR formats at:

WWW http://videoexpert.home.att.net

D6

The D6 tape format uses a 19mm 'D-1 like' cassette to record 64 minutes of uncompressed HD material in most of the current HDTV standards. The recording rate is up to 1020 Mb/s and uses 10-bit luminance and 8-bit chrominance and records 12 channels of AES/EBU stereo digital audio. The only D6 VTR on the market is VooDoo from Thomson and it has been used in film-to-tape applications.

D7-HD

See DVCPRO HD

DVCPRO HD (a.k.a. D7-HD and DVCPRO 100)

This is the HD version of Panasonic's DVCPRO VTR hierarchy. DV and DVCPRO record 25Mb/s; DVCPRO 50 records 50Mb/s; and DVCPRO HD records 100Mb/s. All use the DVC intra-frame DCT-based digital compression scheme and the 6.35mm (1/4-inch) DV tape cassette.

In the recording format, video sampling is 8-bit, 4:2:2 and 1080I as well as 720P formats are supported. There are eight 16-bit 48kHz audio channels. The recording data rate means that considerable video compression must be used to reduce around 1Gb/s video and audio data. Video compression of 6.7:1 is quoted.

A feature of DVCPRO HD camcorder range is the VariCam that offers variable progressive frame rates for shooting from 4-60Hz in one-frame increments.

WWW http://www.panasonic.com/pbds/index.html

HDCAM

Sony's HD camcorder version of the popular Digital Betacam. Introduced in 1997 at 'near DigiBeta' prices it was the first more affordable HD format. Now the expanded range includes still lower priced models. HDCAM defines a half-inch tape recording format. There is also a range of studio recorders and players as well as options for down conversion to SD.

In the camcorder, the camera section includes 2/3-inch, 2.1 million pixel CCDs to capture 1080 x 1920 images. The lenses have compatibility with Digital Betacam products as well as accepting HD lenses for the highest picture quality. The recorder offers up to 40-minutes' time on a small cassette making the package suitable for a wide range of programme origination, including on location. A series of steps, including 4.4:1 intra-frame compression, reduces the baseband video data rate to 140Mb/s. The format supports four channels of AES/EBU audio and the total recording rate to tape is 185Mb/s. HDCAM effectively samples video at 3:1:1 with the horizontal resolution sub-sampled to 1440 pixels. It fulfils many HD needs but is not an ideal medium for Blue Screen work.

Video formats supported by HDCAM are: 1080 x 1920 pixels at 24, 25 and 30 progressive fps and at 50 and 60Hz interlace. Material shot at 24P can be directly played back into 50Hz or 60Hz environments. Also, the ability to playback at different frame rates can be used to speed up or slow down the action.

See also: CineAlta

HDCAM SR

HDCAM SR can record either 4:4:4 RGB or component 4:2:2 HD video at a net video rate of 440Mb/s. It uses mild MPEG-4 Studio Profile (ISO/IEC 14496-2:2001-1) 'visually lossless' compression and records onto 1/2-inch tape cassettes. The Studio Profile addresses the need for high resolution; it is I-frame only and so easy to edit, and scalable in its pixel count (SD and HD), bit depth (10- or 12-bit), and colour resolution (component or RGB). Its applications include high end HD recording, editing and as a mastering format. HDCAM SR is probably the highest quality HD tape recording system available. Practical recorders at any higher bit rate use hard discs or flash memory.

Besides working at the 440Mb/s rate, called the SQ mode, HDCAM SR also offers an HQ mode with recording at 880Mb/s to offer lower compression 4:4:4 RGB or two 4:2:2 channels.

HDV

HDV is a low cost system for shooting and recording HD. It defines video formats, a compression scheme and uses DV recording and familiar DV, or MiniDV, cassettes. HDV is available in two standards HDV1 and HDV2 but, unlike DV, they use MPEG-2 long GOP compression to squeeze the HD video into DV-sized data. 4:2:0 colour 8-bit sampling is common to both standards. The two channels of 16-bit/48Hz audio are compressed (4:1) with MPEG-1 (Layer II) to 384 kb/s.

HDV1 is 1280x720 progressive scan format with frame rates of 60, 50, 30 and 25Hz. JVC's ProHD adds a 24Hz frame rate. The luminance sampling rate is 74.25MHz. The video is compressed using MPEG-2 six-frame GOP compression to produce a recording data rate of just 19 Mb/s. In this standard a 63-minute MiniDV cassette records 63 minutes of HDV and, with critical data interleaved over all the recorded tracks, dropouts are minimised.

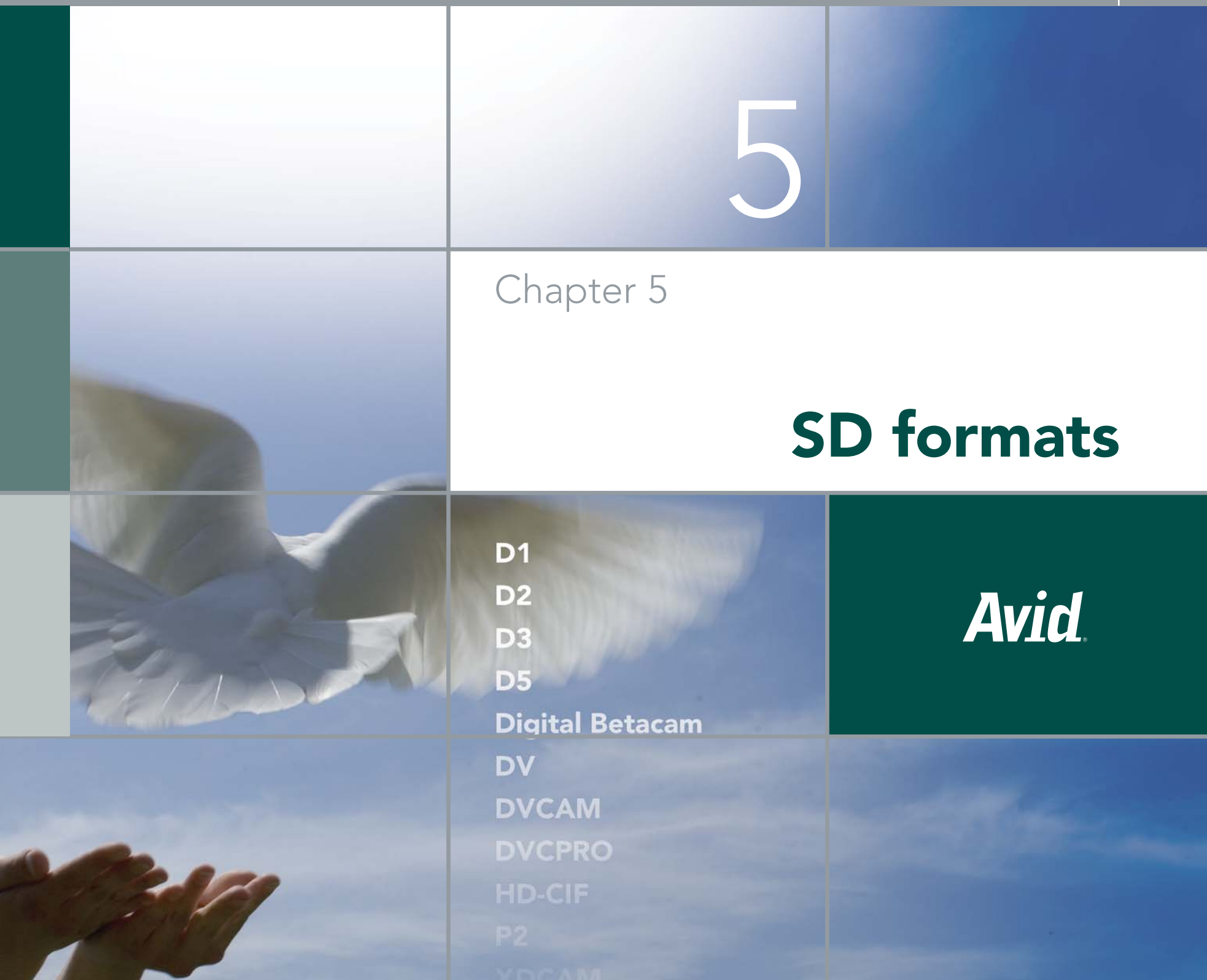
HDV2 is a 1440x1080 interlaced scan format with frame rates of 60 or 50Hz. The data rate is 25Mb/s after applying MPEG-2 15-frame GOP compression. Note that the pixel count is not in the usual 16:9 pixel/line ratio, but the pictures themselves are. So here luminance sampling rate is 55.7MHz and the pixels are not square but are stretched to an aspect ratio of 1.33:1. This is the same luminance sampling as is used in HDCAM.

ProHD

ProHD is JVC's adaptation of the HDV 720P recording mode that adds 24-frame progressive scan 24P – but not for the 1080-line format. This is useful of productions seeking a film look or wishing to output to film or D-cinema as it avoids the never-perfect process of deinterlacing. Apart from adding 24P, ProHD uses the same compression and bitstream format as HDV.

XDCAM HD

Sony's XDCAM HD records 1080I 4:2:0 HD at bit rates of 18, 25 and 35Mb/s onto Professional Disc media (Blu-ray). The 25Mb/s is a constant bit rate to give users a bridge to HDV, and the other two rates are variable. 18Mb/s allows for a recording time of two hours, and the other two allow for 90 and 60 minutes. User can mix the different bit rate on the same disc. As with HDV, long GOP MPEG-2 compression is used.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Chapter 5
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Standard definition has a wide variety of digital tape formats to suit everyone from consumers to broadcast professionals. Recent trends include more compact formats and lower costs. Many of the HD tape formats have their routes in SD including HDV that uses the widely used (SD) DV format.

D1

Digital tape format to record SD uncompressed 4:2:2 component digital 625 and 525-line video onto 19mm (3/4-inch) cassettes. Introduced by Sony in 1987 it was relatively expensive and used for high-end work where multi-generation quality needed to be maintained. It is not widely used today.

D2

Introduced in 1988 by Ampex, this records uncompressed digitised composite PAL or NTSC video onto 19mm (3/4-inch) cassettes. Although it used less data, and so less tape, than D1, and was good for analogue transmission replay, the signal suffered from all the original restrictions of PAL and NTSC. It was little use in modern post production and would have to be decoded for any digital transmission. The format is little used today.

D3

Introduced by Panasonic D3 is similar to D2 in that it records composite PAL or NTSC video onto cassettes, the D3 ones being 1/2-inch. As it has the same benefits and drawbacks as D2 and is not widely used today.

D5

Introduced by Panasonic in 1994 this records uncompressed 625 and 525-line 4:2:2 10-bit component digital video onto the same half-inch cassettes as D3. Being component it uses in post production and, as it has lower costs than D1, is still in use today. The format also has provision for HDTV recording by use of about 4 or 5:1 compression (see HD-D5).

Digital Betacam

Launched in 1993, 'Digibeta' superseded the analogue Betacam formats and costs much less D1. It provides good video and audio quality and run time up to 124 minutes. 720 x 576 or 720 x 480 4:2:2 component SD digital video is DCT-compressed to a bitrate of 90 Mb/s (about 2:1 compression) plus 4 channels of uncompressed 48 kHz PCM audio.

DV

Launched in 1996, DV (IEC 61834) defines both the codec (video compression system) and the tape format for the first SD digital tape format for the consumer and prosumer markets. Features include intra-frame compression for straightforward editing, an IEEE 1394 interface for transfer to non-linear editing systems, and good video quality compared to consumer analogue formats.

Variants include the DVCPRO series and DVCAM. Also, much of HDV has its roots in DV including the MiniDV tape, but not HDV's use of MPEG-2 compression.

DVCAM

Introduced by Sony, DVCAM is a professional variant of the DV standard that uses the same cassettes as DV and MiniDV, the same compression scheme, but runs the tape through 50 percent faster making it more robust with fewer errors/dropouts.

DVCPRO (25 and 50)

Panasonic created the DVCPRO range for professional applications of the root DV technology. Also known as DVCPRO 25, DVCPRO is identical to the DV format for recording, and uses a 25Mb/s recording stream. There are two tracks of 16-bit, 48kHz audio and video is sampled at 4:1:1 for both the 576/50I and 480/60I versions.

DVCPRO has a hierarchical structure that doubles the data rate. The next step up is DVCPRO 50 with 50Mb/s from the tape that allows reducing the video compression and the use of 4:2:2 sampling to give the better image quality required for studio production. Four 16-bit, 48kHz audio tracks are provided.

HD-CIF

See Common Image Format

P2

Solid-state recording system from Panasonic that records DV, DVCPRO and DVCPRO HD video onto flash memory to offer advantages of speed and reliability over tape, but at a high cost and with shorter run times. Currently available P2 cards offer up to 8GB storage – enough for about 40 minutes of DV, 20 minutes of DVCPRO 50, and 10 minutes of DVCPRO HD. But the random access and 'loop' recording possibilities mean this space is more useful than the equivalent length of tape. The workflow may include in-camera shot selection and very fast data dumping to hard disc storage for editing.

XDCAM

Sony's camcorder that uses Professional Disc media. It records Sony's MPEG IMX (MXF compatible) format, 8-bit I-frame (only) MPEG-2 at 50, 40 or 30 Mb/s – claiming Digital Betacam quality with the highest bit rate. The rates give 45, 57, and 68 minutes recording time respectively. Some models can also record the 8-bit DVCAM format with 5:1 compression and 4:1:1 sampling for the 480/60I system (NTSC) and 4:2:0 for 576/50I (PAL) system. DVCAM recording time is 85 minutes.

See also: MXF