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Technology

HD simplified!

By Neil Sadwelkar

HD or HDTV, short for High Definition Television, is that technology that is supposed to be part of our lives at some point of time. Except that no one knows yet, when and in what form this technology will become prevalent. In India as in the West, HD adoption is moving slower than its proponents would like it to, partly due to high equipment costs, and in some part, due to ignorance. Since I can't do much about the former, let's see what I can do with the latter.

HD is not just one format like *Betacam* or *Digital Betacam*, nor one standard like *NTSC* or *PAL*. It is really an umbrella of standards, and tape formats - all with a higher resolution than that of Television and video today. Originally HD was supposed to be a replacement for *SD* or Standard Television - the TV we see today. Just like colour TV replaced black & white TV.

But for HD to completely replace SD, all TV channels and all TV producers will need to upgrade all existing shooting, editing and transmission equipment to HD. And to see that HD all of us have to get new HD TV sets. So HD replacing SD in homes is some way off, still. HDTV transmission over the current analog RF transmission systems that our cable operators and broadcasters provide, won't work either. So all telecast and cablecast systems have to convert to digital before HD is possible.

High "Definitions"

Anyway, when [and not if] HD comes along, the HD standards that we will be dealing with boil down to -

1. **1080 and 720.**
 1080 is a frame size or the *horizontal resolution* of 1920x1080 pixels. 720 is a frame size of 1280x720 pixels.
2. **"i" and "p".**
 "i" is interlaced, meaning 2 fields per frame. Just like TV is today.
 "p" is progressive. Meaning no fields, just frames. Just like film is today.

That's it. Just remember these two broad divisions. 1080 or 720 and *i* or *p*.

And within each of these you can have a frame rate of 24, 25, 29.97, 30 in "p" and 50, 59.95 and 60 in "i". So no more *NTSC* or *PAL* or *SECAM*. Just specify frame size and frame rate. And till HD television becomes prevalent, your choice of shooting and editing standard will be dictated by the end use of what you are creating, and not the country you are in.

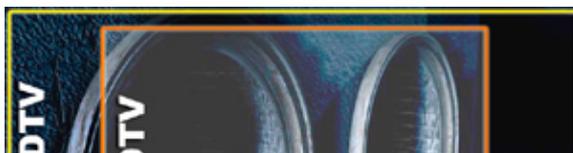
Apart from "i" and "p" one also encounters "**PsF**" as in *25PsF*. This is *segmented frames*. Meaning 25fps non-interlaced while shooting, but each frame broken down into "*segmented frames*" - one composed of odd lines, the other of even lines - before recording to tape. *PsF* is used to ensure compatibility between progressive and interlaced material.

In India we would shoot and edit in 1080/24p if the final film is for theatre release. Or 1080/25p or 1080/50i to use HD in place of film for TV-only use, like commercials, TV serials, or sports. I doubt if we'll ever use 30p or 59.94i or 60i.

Incidentally many - if not most - HD equipments also support today's TV - meaning *SDTV*. They express these as 480i or 576i for *NTSC* and *PAL* respectively. In other words, when HD becomes prevalent and SD becomes outdated, they will call today's *NTSC* video tapes 480/60i and today's *PAL* tapes 576/50i.

These "definitions" above may seem oversimplified. But there are much more complicated definitions, available for the purists. Go ahead and read up about them on the web.

Stretch your imagination



Another characteristic of HD resolutions is that both these basic resolutions - 1080 and 720 - have a native 16:9 aspect ratio. Meaning, 4:3 material would appear stretched to fill, or with black band on the sides, or

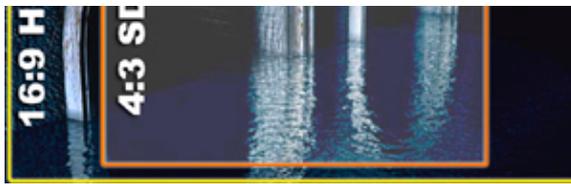


image courtesy: Jayan Narayan

will have about 5 times as many pixels as an SDTV. And even if the HDTV is only 720, it will still have a frame size of up to 1280x720 pixels which is still more than twice as many pixels as SD.

The optimum viewing distance for today's SDTV is 8 times the screen height. So a 25" [measuring about 14"x18"] TV should be seen from about 9 feet away. If you get closer, you'll see a larger image, but it will get blurred and unclear.

But if the same TV set were an HDTV [14"x24"], you could see it from 3 times screen height or just 3½ feet away. Another way to look at this would be, if you had a 25" SDTV set placed 9 feet away, at the same distance you could comfortably watch a 75" HDTV. Wow!

So HD means higher resolution, larger [effective] screen sizes and widescreen TV watching. Almost "Cinema at home"!

Formats

This formats section is rather complicated and may require some concentration. Make sure you don't read it on an empty stomach.

The two major HD tape formats at the present time are **HDCAM** from Sony and **HD Cinema** from Panasonic. These two formats are incompatible with each other, as usual [hopefully a day will come when we can start using products from 'PanaSonyc']. Tapes of one won't play in the other. Apart from these two, there is also a JVC and a Philips format, but they appear to be lagging behind in terms of acceptance. So at the outset, we will have to adopt one standard, one manufacturer. Just like good old Betacam and Digital Betacam from Sony versus M-II from Panasonic. How times change!

At the present time it's hard to say which format will become prevalent in India. Sony's **HDCAM** may have the edge as their decks are compatible with the existing Betacam and DigiBeta tapes. On the other hand Panasonic's equipment can record SD as well as HD, so they could replace today's Beta and DigiBeta as well as offer HD. Choices, choices!



Panasonic's HD cameras - There is the **AJ-HDC20A** camera [US\$ 60,000] which can shoot in 1080 at 59.94i only. No 24p, no 25 p and no 50i. Or the **AJ-HDC27A** [US\$ 55,000] camcorder that can shoot in 720 at 60p but not at 24p or 25p or 50i. If we had to use these machines in India we would have to convert 59.94i or 60p that these cameras work in, to 24p to be compatible with our cinema, and to 50i to be compatible with our TV. What these conversions mean in terms of artifacts, I don't know. These machines look like they were not designed for PAL countries.

But wait, there's more. Panasonic also makes the **AJ-HDC27A** [US\$ 63,000] variable frame rate camcorder [Varicam] that can shoot in 720 at various frame rates. According to Panasonic, "The 'AJ-HDC27' VariCam serves a triple role: 1.) as a 24-fps camera, 2.) as a standard 60-fps video camera, and 3.) as a variable frame rate special effects camera." Whatever frame rate you choose the camera still records at 60 fps. There is an interesting if somewhat oblique explanation about exactly how this 24 fps at 60 fps works. Check it out at Panasonic's Varicam page.



Mind that the Varicam is a 720 device, so if you have to work at 1080, it's not for you.

To edit these recordings, there are Panasonic HD Cinema edit VCRs like the **AJ-HD3700B**. These HD VCRs can also play and record SD resolutions. Unlike Sony's HD VCRs that can play [but not record] SD tapes.

This capability of Panasonic VCRs is a big plus for a transition from SD to HD. Except that the VTR capable of this costs US\$ 1,00,000. Meaning slightly more than an S-class Mercedes Benz! But the Mercedes goes faster and carries more people - and does run well even on Indian roads. So choose wisely. And by the way, this Panasonic VCR won't play Sony HDCAM tapes.

And... and... Panasonic's HD formats are 8-bit recordings, and use 6.7:1 compression on tape. So all those 10-bit "uncompressed" purists will need to hold their fire for a while before real uncompressed 10-bit comes to HD recordings.

Sony's HD machines are called *HDCAM*. These machines were introduced in 1997, over six years ago. So HD has really been around for sometime. Where were you in 1997?

The top of the line HDCAM camcorder, the **HDW-F900** camcorder [US\$ 1,02,360] is a true 1080 camcorder that can shoot at 23.98p, 24p, 25p, 29.97p and 30p. It can also shoot at 50i, 59.94i and 60i to be compatible with SDTV. You can also shoot at 50 fps in a 25 fps shoot to get slow-mo film style.



There is also the **HDW-750CE** that can shoot at 1080 at 50i. But not 24p or 25p. This machine is aimed at HD shoots for PAL television. It is ideal for sports coverage at HD resolutions.



For editing there is the **HDW-500** [US\$ 49,500] and **HDW-F500** [US\$ 72,100] edit VCRs. The 500 that can play and record 1080 at 59.94i and 60i only. Useless for India. The F500 can play and record 1080 at 23.98p, 24p, 25p, 29.97p and 30p, and 50i, 59.94i or 60i. Truly universal. And seriously expensive.



And there is the **HDW-M2000/1** [US\$ 60,000] which can play and record 1080/59.94i, 50i, 29.97PsF, and 25 PsF. It can also play back [but not record] tapes at 24PsF and 23.98 PsF. Incidentally, this VCR can play back Betacam and Digital Betacam tapes as well, and convert them to 1080i for use in an HD production.

So to make it simple if not sweet - if you shoot at 24p, you need the F900 camcorder and the F500 edit VCR, to make your film. Your 24p tapes will play in the M2000, but you can't dump back 24p

edited stuff to the M2000. If you shoot 50i, you can use the F900 or the 750 camcorder. To edit, you can use the F500 edit VCR or the M2000 VCR.

Sony's HD is also 8-bit and uses 4.4:1 compression. Here again 10 bit uncompressed need some breath-holding till some uncompressed 10-bit HD format is feasible.

Apart from Sony and Panasonic, JVC has recently introduced a middle-class HD camcorder the **JY-HD10U** [US\$ 4000.00]. This works in the 720p mode and uses MPEG-2 compression to record to tape. This camcorder might be an ideal system for those who shoot corporate films made for projection on large screen during product launches etc. The high resolution and wide-screen that HD offers is ideally suited for this application. It also ships with an editing application. The HD10U uses normal DV tapes to record on, and can also record in normal DV resolutions.



Editing HD

Compared to shooting, recording and transmission, editing HD material poses comparatively more manageable challenges. To get an idea of the data rates of HD and disk space requirements, see this...

Format	Data rate MB/sec	Space per min GB	Space per Hr GB
DV	3.6	0.2	12
2:1 compressed	12	0.7	43
Uncompressed	24	1.4	86
HD 1080	121	7.3	434

This makes it clear that to edit HD, you need some serious gear. 121 MB/sec every second for as many as a few hours can tax the best of systems today. Fortunately disk arrays today can handle these loads.

Among software, *Final Cut Pro* from Apple is built to work in HD. To an FCP system you need to add a *Kona HD* card or a *CineWave HD*, acquire a wide-screen Cinema display, and Apple's *X-RAID* disk array. A complete package consisting of all the above was recently being promoted by Apple in India for under Rs 20 lakhs. One studio in Central Mumbai is said to be acquiring this setup.

Avid markets the *DS Nitris HD* system that is HD capable. This all-in-one editing and compositing system works on the DS interface, which itself is getting closer to Avid with each release.

Quantel also has an HD solution in their *Q-edit* line of systems. And their existing *Paintbox*, *EditBox* and *Henry* systems can be upgraded to HD.

Discreet smoke, *flame*, *fire* can all be upgraded to HD. How much of a pain or expense this is, I have no clue.

Sony also markets their own proprietary *Xpri* editing system for HD editing. This is tightly integrated with their own HDCAM machines and supports all formats that their machines can shoot and record.

To edit HD programs, it is not necessary to work at HD resolutions, at least for the primary offline resolution. After shooting in HD, it is possible to "down-convert" these HD tapes into normal PAL SD tapes on Betacam and also DV. This can be TC-locked to the original. These DV or Betacam tapes can then be used as source to edit in any normal non-HD system. After editing is complete an EDL from the offline session can be used to upgrade the film from the original HD material directly.

What about us?

How and when, one is likely to be working with HD in India? This is a matter of conjecture at the moment as there appears to be no clear transition to HD in sight. There is yet no legislation requiring any of us to convert to HD at any point in time.

My feeling is that HD will creep into our work over a period of time. In the US, there are already Direct-to-home [DTH] TV stations offering HD transmissions. TV sets cost \$ 3000 upwards. In India too, some premium movie channels may come out with HD transmissions at first. These will be completely incompatible with existing TV transmission and recording - so piracy can be curbed. This may even be a driving force behind HD movie transmissions. Then there's cricket. Some premium TV channels may show cricket matches, maybe the World Cup 2007 in HD to a small audience. DTH HD receivers could cost about Rs 20,000 to Rs 30,000 and TV sets Rs 1,00,000 upwards.

On these premium channels, TV ads would initially be SD copied from existing TV ads. And since most ads are shot on 35 mm film, it's only a matter of time before one soft drink does their post in HD. Then the other soft drink will follow. Then a toothpaste, a detergent, a car, and gradually all ads will be mastered in HD.

Or movie producers who make movie promos for TV may make their promos in HD - so that they can release the same promo on TV and make a conversion to film for theatre release.

In post-production facilities in India, the number of HD machines has increased by a whopping 100 % in the past year. Last year there was one HD edit VCR in India. This year there will be two. So we really have a long way to go here.

In homes, initially just a few people will get HDTV sets. Then as the price falls, getting an HD-capable set will cost only a little more than SD. And more people will get them. On the other hand, most computer monitors 17" and up, capable of 1024x768 can show the "lower" HD standard [or near-HD] of 720 and larger monitors capable of 2048x1536 can show the "higher" HD standard [or true-HD] of 1080. And many homes have these monitors, so are technically HD-ready right now.

Video projectors too are HD capable depending on their peak resolution - SXGA and up. So HD screenings at high-profile product launches, company meetings, fashion shows etc is possible even now.

For consumer-level storage and delivery of HD will use either *Windows Media 9* files which can even today play out HD at modest data rates. *QuickTime* too has this capability with a new HD codec that produces great images at a fraction of the space required. *MPEG-4* too has some HD capabilities. And who knows what other format is lurking in the shadows.

It is at this level that I believe HD will fly first in India. Someone somewhere will get his hands on an HD movie in *WM9* or *QT* or *MPEG-4* format. Then see it on a computer. Then share a copy with a friend. And so on. Soon thousands will see HD material at home.

About Neil Sadwelkar



Neil Sadwelkar has little formal training, so he just about makes a living in the film & TV industry in India. His profession is a higher form of meditation through which one can deny hunger and sleep - it's called editing. In his spare time thinks hard and writes stuff like this piece above. And in whatever time is left over, he does his own accounts and chases clients for money. As you must have noticed by now, he is also shamelessly besotted with Macintosh machines and considers them as God-sent gifts to man kind!

He builds and tinkers with computers, so some people get conned into believing that he knows a lot about computers and editing software, so they even pay him as a consultant. Really! If you love what he's written you can drop him a line at neil@misenscene.net and tell him he's the greatest. He even has a web site dedicated to Final Cut Pro where you can take in more of his writings.

If you're a budding editor you can make him feel good by asking for advice. But if you're looking for work, don't bother because he doesn't have contacts. And if you really hate his writings, write to him and give him some work, so he has no time to write stuff like this. But don't make him chase you for money; else he'll go back to writing.