TV systems and displays

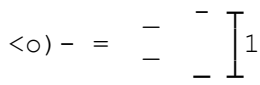
By G8MNY (Updated Jul 09)

Some time ago I went to another HDTV lecture held at a local ham club (Sutton and Cheam), the previous one was 20 years ago an IEEE at Kingswood BBC research establishment.

FORMATS

In 20 years has not seen a much change really, it used to be 1250 line (1150 visible) @ 100Hz frame per second rate 16:9 format, to be sort of comparable with 625 line PAL (575 visible lines) being 8x that data rate. But the new versions (4 of them) made to be USA friendly, are worse. The best is only 1080 visible lines at 25 F/S & the worst 720 lines at 25/50 F/S there are (P) progressive update formats of both types to improve visible motion by keeping interlaced frames (time) separate, this overcomes most of the smooth motion problems but keep the high compression systems.

For TRUE "HDTV" large displays capable of full resolution are needed, as the normal eye can only perceive 1 min of arc. So for a screen of 1080 visible lines you need to see this as 18° tall by the eye.



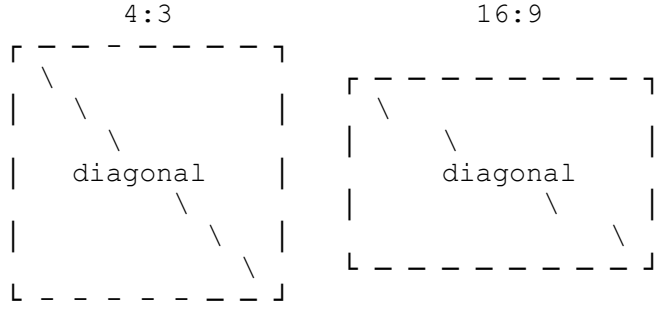
If your sight is worse than perfect then you well need to be even closer than the distances below.

Note many screen are "HDTV Ready" this means they are only plug compatible & may not be capable of displaying an improved picture definition at all! See the Pixels per line it needs to be at least as good as the HDTV source is.

SCREEN SIZE

Here are the MAXIMUM viewing distance to "just" see the detail of a pixel..

SYSTEM \ DIAGONAL	9"	14"	21"	28"	30"	33"	37"	40"	42"	50"	FACTOR
380 Line 4:3 405 Old	48"	75"	112"								5.35
480 Line 4:3 525 USA	60"	86"	90"	120"							4.29
575 Line 4:3 625	32"	50"	75"	100"	107"	118"	132"	143"			3.57
575 Line 16:9 625	26"	41"	61"	82"	88"	97"	108"	117"	123"	146"	2.92
720 Line 16:9			47"	65"	70"	78"	86"	93"	98"	117"	2.33
1080 Line 16:9			33"	43"	46"	51"	57"	62"	65"	77"	1.55



Note what your eye appreciates is not the picture width, but the total picture area! So 16:9 gives big screen diagonals with smaller actual picture area! Also if the central area is smaller, you will feel cheated.

So to appreciate what HD offers, you really do need a big screen and sit close up to it, otherwise you're wasting your time and money.

Example: If your upgrading from say a 21" 4:3 TV you view at 6ft, to a 16:9 HDTV at the same distance you will need a huge 50" screen!

The original HD trial CRT TVs of 20 years ago were a maximum of 30" & weighed in at a heavy 185kg, and unless you had double door access on the ground floor, you weren't getting one!

HD or not HD, many modern displays can't actually reproduce the definition, even though they are marked/sold as "HD ready"! That just means they have a compatible connector and software that can either degrade definition or zoom in missing the edges, that is all! Whereas ones that are truly HD, can't display normal TV as well as a normal TV due to poor conversion systems algorithm /small picture area options.

SCREEN/TV TYPES
There are 5 types all with their problems...

1/ CRT. Heavy & bulky. A fluorescent phosphor determines the colour per screen dot, illuminate by 3 fast scanned electron guns via a shadow mask that removes 75% of the electron beam (and power) and generally half of the phosphor light is lost into the tube giving over all transfer efficiency less than 12%! Some tubes use blackened glass to help see the blacks better in strong room light, reducing the efficiency still further. All CRTs produce some X-Ray emission. The Phosphor dots and line structure often cause more patters on a well focused tube! Phosphor screen and shadow mask can be damaged by internal tube dirt if transported screen down.
Dot size varies with brilliance · * · ■ and this shows up the line structure.
All bright dots have a ring halo from electron wavelength used. (·)
Gamma Gun correction is transmitted for CRT characteristics so the maker does not have to bother with the correction curve.
When new CRTs give very good bright picture (1000 Cd/M^2) with good definition, but age to give blurred highlights & sometimes burnt screen areas. Also uneven gun emissions affect colour balance.
Sharp focus often variable over screen.
Lifetime good 20,000 hrs, if the QRO 16:9 LOPTY stage does not fail!
Colours can change with age/magnets.
Good viewing angle, but normally a curved screen!
Quite high QRM at multiples of line frequency & from SMPSU, as well as some changing video frequency radiation.

2/ LCD Panel. Has very high levels of back fluorescent lights needed all the time,as only about 10% of light entering the panel can get through to the front. The light is polarised (60% loss) the LCD cell were (10% more is lost),then another polariser and then the colour filter(75% loss)/pixel.
LCDs are well known for slow response (motion drag) due to slow cells some are faster nowadays, but not all!
Imperfect polarisation nulling results in poor blacks, this is very viewing angle related, the good contrast ratio figures often quoted are only from 1 viewing angle only!
The gamma curve is often poor due to the non linear polarisation nulling process in the LCD cells, which effects the true colour rendition.
Pixilated screens are always sharp! LCDs can't normally get "picture burn ins".
Standard conversion to the screen format may produce poorer moving pictures than expected. Also picture delay resulting in lip sync problem on some sources. Brightness limited to about 500Cd/M^2 max.

Susceptible to random pixel /addressing (stripe) failure. Tube failure and UV degradation of the polarisers also occur.
QRM fairly high from large screen address wires radiating, and QRO lamp SMPS.

3/ PLASMA Panel. Like CRT, a fluorescent phosphor determines the colour, illuminate by a UV from a Mercury arc as in a fluorescent tube lamp but per
pixel. Most of the light produced leaves the front of the screen, but the high power drivers are inefficient.
Some artefacts can be visible if you scan your eyes fast as the pixels are not on continuously.
Lifetime dependent on brilliance but around the life of the average CRT nowadays.
Viewing angle very good, good real contrast figures.
Pixilated screens are always sharp!
Like CRTs it can easily get picture burn in if bright static picture is left on for hours. Displays have anti burn strategies to reduce the chance of this.
Colours are VERY TRUE, as pulse width control is used vary each pixel's brilliance, there is no gamma correction needed, and brightness is much higher than CRTs or LCD display at about 1500 Cd/M^2.
Screen is quite delicate, not thick glass like a CRT, as back of display touches the front, also must be kept vertical for transport because of this!
Standard conversion to the screen format may produce poorer moving pictures than expected. Also picture delay resulting in lip sync problem on some sources.
Susceptible to random addressing (stripe) failure.
QRM high from power in screen address wires radiating and the QRO SMPSU.

4/ LCD Projection. These need very bright white light from expensive Xenon arc lamp lifetime up to 6000 hrs for under run lamps. (2000 on some projectors)
N.B. these lamps can explode!
The light is split into 3 colours with mirrors, feed the 3 polarisers, 3 LCD tiles & a 2nd polariser per colour, before being recombined in a colour splitting prism (optical block) & then to the single projection lens.
Incident light a real problem for black on all projection screen systems.
The gamma curve is often poor due to the non linear polarisation nulling process in the LCD cells, which can effect true colour rendition.
Standard conversion to the screen format may produce poorer moving pictures than expected. Also picture delay resulting in lip sync problem on some sources.
Susceptible to random pixel / addressing (stripe) failure. Also due to heat and UV failure/damage of LCD tiles & polarising filters in the optical block.
Due to optics focus etc. there will be some aberration/fuzziness.
Dirt in air degrades optics difficult to maintain spotless!!
Easy to get a large screen, with rear projection system or ceiling mount.
Fan cooled, must be cooled off after use. QRM from lamp SMPS.

5/ DLP Projection. Rotating coloured wheel and reflected pixel tile system.
These give very bright pictures, also using expensive Xenon arc lamps of limited lifetime. N.B. these lamps can explode!
Main problem is the colour flicker due to the wheel, making reading text and moving pictures quite eye aching.

Standard conversion to the screen format may produce poorer moving pictures than expected. Also picture delay resulting in lip sync problem on some sources.
PC grade definition is VERY GOOD if the standards are set right and no converted done, may not be quite as good on HDTV as from PC.
Susceptible to random pixel /addressing (stripe) failure. Also due to heat and UV failure of mirror tile block with age will occur.
Due to the light source variation a set of these projectors in a wall, are difficult to keep colour balanced between them for TV studio use.
Due to optics focus etc. there will be some slight aberration/fuzziness.
Less optics than a LCD, but dirt in air degrades optics difficult to maintain spotless!!
Easy to get a large screen, with rear projection system or ceiling mount.
Fan cooled, must be cooled off after use. QRM from lamp SMPS.

6/ Organic LED displays. Just coming on the market at huge cost, the printed colour LEDs on flexible foil system. These look like being the future as they are efficient, but as yet not very bright, not big, and sort lifetime.

The broadcasters are still deciding what standard to adopt to give the best pictures, as each type of display types ideally needs different production system / technique to give its best!

DEMO
At the lecture, the BBC chaps had a SONY 30" 720 x 2000 pixel LCD that looked very good, but it produced a blue for back! They were able to show the same pictures that I originally saw 16ft x 9ft from a huge £1M LCD RGB projection system 20 years ago, but not as clear on the Sony TV! Some of the early stuff was made with a modified 1" vidicon camera producing 40MHz bandwidth per colour, this was an extreme a challenge for the 4 linked up digital recorders at the time!

Split picture comparisons of normal and HD were appreciated and showed the difference could be seen by many, but by no means all could see a difference.
With a standard aerial installation they also tuned into a London HD test and compared off air HD to off air normal freeview.

COMPRESSION
TV starts out at the camera at a HD studio camera at an amazing 1.2Giga B/S, but it is compressed down & broadcast at only 19MB/S, normal widescreen TV is between 10MB/S to as low as 1 MB/S on some channels! Which is why it is often full of annoying MPEG artefacts. (easily seen on a large screen)

Better compression systems are around, but to compress at all, will always produce some artefacts when doing something unusual with the picture.
e.g. cross fade or shake camera, need 25/50 new frames per second, not the 1 or 2 digital give you!

Most channels (except BBC1) use a shared statistical multiplexer, this allows for more channels most of the time, but with the odd few seconds where there is not enough bandwidth to cope with demand and a channel picture will then freeze awaiting some spectrum to become available for an new I frame for example. This is nothing to do with errors!

CONVENTIONS
Note also that HDTV systems are often worse at displaying standard TV as

horrible up conventions are done!

SPECTRUM
When the UK analogue TV is switched off in 2012, the spectrum freed up will not be available for HDTV! The broadcasters are expect to cope with what they have and encourage more/better compression or to buy back commercial spectrum for HDTV.

A new version of Set Top Boxes will be needed for everyone for HDTV at some time. Already 1 upgrade in Aug 2008 made 250,000 TV screens go blank after an upgrade leaves Freeview boxes 'obsolete'.

Y Don't U send an interesting bul>?

73 de John G8MNY @ GB7CIP