A Guide to Shopping for a New TV

You have probably seen advertisements for Digital Television recently, including Digital Cable TV programming. Well, all TVs have digital circuits in them, including the ones you own right now, if they are less than perhaps 10 years old. In fact, many electronic products, including your electric shaver and microwave oven, have digital circuits for one purpose or another. So, if you are in the market for a new TV, and have been dazzled by all the emphasis on “digital”, put that word aside for now, because you could walk into the TV store, pick a TV set blindfolded, and you would have a digital TV.

Instead, we will break down new TVs into three categories for you to consider when shopping. This will keep it simple, and you will know what you are getting for your money.

Category 1. ***Standard Definition TV, or SDTV***. This is the kind of TV you probably own right now. Its picture tube face is shaped sort of like a box, with a ratio of width to height of 4:3. This means that it could be 40 inches wide x 30 inches high, 4 feet wide x 3 feet high, 20 inches wide x 15 inches high, etc. This ratio of width to height is called the Aspect Ratio. Keep in mind that TVs are normally marketed by size according to the distance from the bottom left corner to the top right corner, in other words, diagonal. So, if the ad says it is a 60” TV, the 60” is most likely the diagonal distance, not the width or the height. The reason for this is that the diagonal is a larger number than the width. Welcome to advertising!

The Standard Definition TV has another characteristic that you need to know about and understand. This is called the Scanning Rate. A TV picture is produced by drawing it from top to bottom, starting in the top left corner, and ending up in the bottom right corner. It is drawn left to right, in lines. There are 480 visible lines on this kind of TV, also known as an NTSC TV, one above the other, top to bottom. However, the lines are not all drawn consecutively. First, all the odd numbered lines are drawn, lines 1,3,5,7, etc., up through line 479. Then, lines 2,4,6,8, etc., up through line 480 are drawn. The odd numbered lines take $1/60^{th}$ of a second to draw, and then the even numbered lines take another $1/60^{th}$ of a second to draw. The set of odd numbered lines is called a Field, as is the even numbered set. Together, the two fields make up what is called a Frame, sort of like a frame of movie film. The Frame therefore, takes up $1/30^{th}$ of a second to be shown.

The Scanning Rate for NTSC TV (the Standard Definition TV) is 15.75 kHz. This means that 15,750 lines are drawn each second. So, if there are 480 lines, all of which are drawn in $1/30^{th}$ of a second, you multiply 480 x 30 and get . . . 14,400. Whoops! That does not equal 15,750. Where did the other lines go? Well, those lines are lost during the time that the part of the circuit drawing the lines has to go from the bottom right corner back to the top left in order to begin scanning the

face of the picture tube again. But, the scanning frequency has to remain at 15.75 kHz in order to make up for that lost time.

NTSC TV is also called 480i, and 720x480. The “I” stands for “Interlaced”, meaning that the odd numbered scanning lines are “interlaced” between the even numbered scanning lines. The 480 refers to the 480 horizontal lines, while the 720 refers to 720 picture elements, or “pixels” that are spread out across each scanning line.

The problem with the SDTV is that you can see those scanning lines, because there is an instant of time difference between showing the odd numbered lines and the even numbered lines.

The SDTV is the oldest technology, and will likely be the least expensive type of TVs in the store. If you are happy with technology from the last century, then the SDTV is fine. Otherwise, read on.

Category 2. ***Enhanced Definition TV, or EDTV***. This type of TV takes SDTV one step further. It has a capability of twice the NTSC scanning rate, meaning 31.5 kHz, which is 15.75 kHz x 2. What this allows the TV to do is draw all 480 horizontal lines one after the other, rather than all the odd ones followed by all the even ones. So, line 1 is drawn, then lines 2,3,4,5,6,7, etc., all the way out to line 480. The effect this has on your viewing is dramatic. The scanning lines will no longer be as visible as they are with the SDTV.

The 480 consecutive lines are also drawn faster than with NTSC. Whereas NTSC draws them in $1/30^{th}$ of a second (odd in $1/60^{th}$ and even in $1/60^{th}$), the EDTV draws all 480 lines in $1/60^{th}$ of a second. All 480 lines are flashed on the screen twice, so that you are seeing the picture info spread out over the same amount of time that it would be with the NTSC.

While NTSC (SDTV) is called 480i as mentioned above, EDTV is called 480p. The “p” stands for “Progressive” since all 480 lines are scanned (drawn) one after the other, rather than odd numbered ones first, followed by the even numbered ones.

EDTVs can be in the 4:3 aspect ratio mentioned above, but also in 16:9, sometimes referred to as Widescreen TVs. Advertisements will say that they are “wider” than regular TVs, but what they are actually referring to is the fact that the *ratio* of width to height is larger, or wider, not the physical width. In other words, you could buy a small widescreen TV, say 30 inches wide, and a large SDTV (NTSC), say 50 inches wide, and the SDTV would be physically wider than the widescreen TV, but the ratio on the widescreen TV is wider than the NTSC TV.

If you buy an EDTV, get one that is 16:9. The reason is that programming is shifting more and more to 16:9, away from 4:3. This includes even just regular programs.

Category 3. ***High Definition TV, or HDTV***. This is the kind of TV we suggest you purchase. It will bring you into the 21st century big time. HDTVs are 16:9, but there are a few oddball ones that were made as 4:3 for some reason. Bypass the 4:3 HDTVs and go right to the 16:9s. HDTVs will scan at NTSC rates (15.75 kHz), and also at EDTV rates (31.50 kHz), but also at even higher rates. This is because the new technology, High Definition TV, requires more scanning lines than either SDTV or EDTV.

There are two basic "flavors" (formats or resolutions) for HDTV. One is called 1080i, or 1920x1080. It is an "Interlaced" format (thus the "I" in 1080i), so the horizontal lines (1080 of them in HDTV compared to 480 in SDTV and EDTV) are drawn first with all the odd numbered ones, followed by all the even numbered ones. There are also 1920 picture elements (pixels in the case of LCD flat panel displays - see below) in each line, as opposed to 720 for SDTV and EDTV. As a result, a much faster scanning rate is required to get all those lines on the screen.

The second format is 720p, or 1280x720. It is a progressive scan format, thus the "p" in 720p. All 720 lines are drawn consecutively in 1/60th of a second. It has 1280 pixels in each scanning line.

Because 720 lines have to be drawn in 1/60th of a second for 720p, and 540 lines in 1/60th of a second for 1080i (540 is half of 1080), 720p is actually more difficult for the HDTV circuitry. Therefore, an HDTV capable of showing 720p will be more expensive.

Many HDTVs will take an incoming 720p program and up-convert ("Scale") it to 1080i. In fact, they may even take an incoming 480i program and scale it to 1080i. When shopping for an HDTV, ask at what resolution programming ends up being shown on particular models you are considering. It is very likely that all incoming programming is scaled to one particular format. The best HDTVs will show 720p as 720p, rather than scaling them to 1080i.

SDTVs will only show SDTV, namely 480i. EDTVs will show 480i and 480p. HDTV will show 480i, 480p, 1080i, and if it is a really good unit, 720p. The higher resolutions, 720p and 1080i, are much, much sharper pictures than SDTV. They are almost like looking out a window at the scene on TV, rather than looking at a TV program. This is why they are called "High Resolution". If you have not seen HDTV, be sure you get a demo before making a decision on what you will purchase. My guess is that you will buy an HDTV.

Copy Protection - The TV industry has taken a long time to arrive at HDTV for one major reason: Hollywood wants to make sure its content (movies) are protected from copying, because digital formats, which HDTV is, would otherwise allow exact copies to be made and distributed.

This finally seems to be getting resolved, and you very much need to be aware of how this is being implemented when you buy your new HDTV. These are the abbreviations you need to know: DVI or Digital Visual Interface, HDCP or High Bandwidth Digital Content Protection, and HDMI or High Definition Multimedia Interface.

DVI started out as a way of digitally connecting a computer video card to a digital TV monitor, such as LCD flat panel monitors. Now, DVI is being incorporated into satellite TV boxes, TVs, and soon, such things as DVD players. The DVI connection allows transmission of video in digital format from a satellite box (sometimes called a set top box or STB) and DVD player, to your TV. Obviously, the STB and TV both need DVI jacks. In 2003, about 70% of the new TV models are expected to have DVI input jacks. Buy an HDTV that does indeed have DVI in, and a high definition STB to go with it, including a DVI output jack on its rear panel so that you can connect the STB to the HDTV via DVI.

When going over the features of your selected TV at the store, it should not only have DVI, but HDCP. HDCP is not a jack or plug, but a specification built-into the circuit's memory chips that says the content being transmitted is copy-protected. If it has DVI, but not HDCP, you could end up with either no picture on the screen, in spite of DVI connections, or a reduced resolution picture (1080i being down-converted to 480i or 480p). So, specifically ask if HDCP is enabled on the HDTV along with having its DVI jack. A photo of a DVI plug is shown below.

HDMI is hot on the heels of DVI, and allows not only digital transmission from STB or DVD player to your TV, but very high bandwidth, meaning lots more video information, producing spectacular picture quality. It is also supposed to ensure that future formats decoded by a new STB will be sent to the TV in a standard format that the TV can recognize. HDMI will likely appear in HDTVs towards the end of 2003 and into 2004. Although HDMI is backward compatible with DVI (you will be able to get a cable with DVI on one end and HDMI on the other), not all the information, such as audio, will be transmitted. So, if you want the very latest technology, wait for the DVI/HDCP/HDMI TV sets to arrive later this year. A photo of an HDMI plug is shown below.

Types of TVs – Whereas it used to be that there was just one type of TV, namely the picture tube variety (called a cathode ray tube, or CRT by electrical engineers), now, we have the old CRT TVs, but also, plasma screen TVs, LCD TVs, DLP TVs, and LCOS TVs.

If you buy a rear projection TV (RPTV), it could be CRT, but new ones with LCD, DLP, and LCOS are arriving. LCD (Liquid Crystal Display) types have 3 small LCD panels in them, one each for red, green, and blue colors. A bright bulb shines on these panels, and the images passing through the panels are combined before going through a projection lens to the main viewing screen. DLP (Digital Light Projection) uses a single panel in consumer TVs, because DLP chips are so expensive. As a result, all three colors are flashed onto the single DLP panel one after another in sequence, rapidly. The images are reflected from the DLP panel's surface into the projection lens, rather than passing through the panel as they do with LCD. Some people can see an artifact caused by this (single DLP panel being used), called the "Rainbow Effect". It looks like little red, green, and blue stripes when you move your eyes across the screen rapidly. However, DLP is very bright and has good contrast, giving an excellent image, and some consumers don't even see this artifact. LCOS (Liquid

Crystal on Silicon) is a new technology, and is similar to LCD, but gives more contrast (deeper blacks, rather than blacks that look gray) than LCD. LCOS uses either one or three panels in consumer TVs, but has a different way of handling the three colors (red, green, and blue) simultaneously on the single panel TVs, than does DLP. A variation of LCOS, called Ferroelectric LCD, uses three panels, one for each of the colors.

D-ILA, or Digital Image Light Amplification, is another high definition panel technology, invented by JVC, and is a derivative of LCOS, but it is only in front projectors right now, costing about $15,000 or more.

LCD panels are transmissive, meaning the colored light passes through the panels on its way to the projector lens. DLP, LCOS, and D-ILA are reflective, meaning the colored light reflects off the front of the panels on its way to the projector lens.

A plasma screen TV is perhaps the coolest looking of all the new TV technologies. It is a flat panel (about 4” thick), is bright and has great contrast (you can watch it with full room lighting on), but it is expensive. They range in size up to about 60” and are primarily 16:9. The technology involves very small chambers filled with Neon or Xenon, which emit ultraviolet light when a current passes through them. Phosphor coatings emit red, green, or blue light when the ultraviolet light strikes them. Some plasma TVs are HDTV, but others will only handle 720x480 rather than 1280x720 or 1920x1080. Check to determine the resolution before you buy.

Burned Screens - When watching 4:3 programs on a 16:9 TV, and 16:9 programs on a 4:3 TV, some of the screen will be blank (black bars on top and bottom or on right and left sides). This is because it is the only way to fit one shape of image on a different shape of TV screen. If you watch a lot of such programs, your TV screen could end up with lines visible at the edges of where the blank bars are located. Therefore, you should be careful when watching programs with image shapes that are different than your TV screen shape. Keep the brightness and contrast down. Also, viewing the program in “Zoom” or “Full” modes will fill up the screen with program image and prevent the burned in lines.

Conclusion

We don’t need to go into how each of these technologies works here, but you should be aware of the various technologies that are available when you go shopping. One technology is not necessarily better than the others, but at least you will recognize the names when you see or hear about them in the stores. So, when the salesperson asks you, “How in the heck do you know so much about this stuff?” you can tell them where you read about it.

Here is a list of questions that consumers should ask when shopping for an HDTV:

(1) What is the highest scan rate this TV can display? 480i, 480p, 720p, or 1080i. Keep in mind 720p is a higher scan rate than 1080i. The higher the scan rate, the better the TV.

(2) What type of display device is used in this TV? CRT, LCD, DLP, LCOS, D-ILA?

(3) If it is LCD, DLP, LCOS, or D-ILA, how many panels are used? One, or Three? Three is better. (LCD, DLP, LCOS, and D-ILA are digital panels.)

(4) What is the "Native" resolution of the digital panel? The higher the number the better. The highest available right now is 1364 x 768. Other numbers you might hear are 1280 x 768, 1024 x 768, and 800 x 600. With digital panels, all incoming video is "scaled" to the panel's native resolution.

(5) Does the TV have DVI with HDCP? Does it have HDMI? Does it have a set of component video inputs?

(6) Does it have a built-in High Definition TV tuner, or do I need to purchase one separately?

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