

All About HDTV: Answers To Your Questions

Contributed by Administrator
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Buying a TV used to mean deciding what size screen you wanted, then going out and finding the set with the best-looking picture you could afford--with not much more to it than that. In the end, such basic choices are still mostly what it's all about. Yet somehow the process manages to be, or at least to seem, much more complicated.

One reason is that, increasingly, most of the TVs available today are high-definition models. And along with dramatically improved picture and sound, HDTV brings a boatload of new terminology, new features, and new connection options. To help make sense of it all, here are the answers to the most common and most important questions posed by today's HDTV shoppers.

Q. What is HDTV?

A. HDTV (high-definition television) comprises a family of digital broadcast formats that offer extremely clear wide-screen pictures and Dolby Digital sound. An HDTV broadcast contains about six times as much picture information as a conventional analog TV broadcast.

Q. What does "wide screen" mean?

A. In television, a wide-screen picture is one with a 16:9 aspect ratio--that is, 16 units of screen width for every 9 units of screen height. This is very close to the aspect ratio most commonly used in the film industry and a better match to the human visual field than the traditional, almost square 4:3 aspect ratio of conventional television (and of movies made before the early 1950s).

Q. What are 1080i and 720p?

A. These are the picture formats used for HDTV broadcasts. Some networks and stations use 1080i (CBS and NBC, for example), whereas others (including ABC and Fox) use 720p. TV creates an illusion of motion by displaying a succession of still images. In a 1080i signal, each complete video frame is 1920 pixels (picture elements) wide by 1080 pixels high, transmitted in interlaced format. A 720p signal, on the other hand, contains 1280 by 720-pixel frames transmitted in progressive format.

Q. What is 1080p?

A. Basically, it's a progressive version of 1080i (see above). HD DVDs and Blu-ray Discs carry video in 1080p format; it is not used for broadcast.

Q. What's the difference between interlaced and progressive video?

A. Progressive video presents a complete frame at a time. Interlaced video, on the other hand, builds each frame out of two fields--one comprising the odd-numbered pixel rows, or scan lines, the other the even-numbered pixel rows--which are presented alternately. Whereas the frame rate for 720p (progressive) HDTV is 60 per second (60 fps), the frame rate for 1080i (interlaced) is just 30 per second, but with a field rate of 60 per second.

If you're thinking, "Well, that seems like a bit of a cheat," you're right. It's a pretty effective one most of the time, however, which is why interlacing was adopted for the analog television systems of the twentieth century. It allowed greater effective picture resolution within the transmission bandwidth allotted for TV channels, yet the screen was refreshed frequently enough to avoid obvious flicker on the cathode-ray tube (CRT) displays of the era. Its advantages outweighed its drawbacks.

Q. Which is better, 720p or 1080i?

A. That depends on the amount of motion in the program. For still images or scenes containing relatively little motion, 1080i can deliver greater detail. But 720p excels on scenes containing fast motion. That's why the networks with the heaviest commitments to sports programming have adopted 720p. ABC owns ESPN, for example, and Fox owns many regional sports networks.

Q. What equipment do I need to watch HDTV?

A. Basically, two things: an HDTV set and a source of HDTV programming. You may read or hear slightly varying explanations of what constitutes an HDTV display, but a reasonable rule of thumb is that if it can display a wide-screen image with at least 720 pixel rows, it's HD. So, for example, a 16:9 display with a resolution of 1366 by 768 pixels (columns by rows) is high-definition, whereas a 16:9 display that is 854 by 480 pixels is not.

The cheapest source of HDTV programming is good old over-the-air, with an antenna connected to an HDTV tuner. (You may also see them described as ATSC tuners, after the Advanced Television Standards Committee that defined the new digital TV system.) Most current HDTV sets include over-the-air HDTV tuners, but some, usually called HD or HDTV monitors or designated "HD-ready," do not. In addition, both satellite TV providers, DirectTV and Dish Network, offer HD programming, as do most digital cable systems. You should consult with your satellite or cable operator to determine what HD programming they provide and exactly what receiving equipment you will require to enjoy it. Finally, the latest alternative for HDTV programming is an HD DVD or Blu-ray Disc player, which can play movies or other programs recorded in high-definition to DVD-like discs.

Q. Do I need a special antenna for over-the-air HDTV reception?

A. Not really. HDTV is broadcast at the same frequencies used for conventional TV, and depending on where you are located you might do fine with even a simple set of rabbit ears. If you watch conventional over-the-air broadcasts now, chances are pretty good you will be able to use the same antenna for HDTV as well. One thing you may need to take into account is that a large proportion of stations currently transmit their digital broadcasts in the UHF band, rather than the

VHF band that has traditionally been more popular, so you will probably need an antenna that includes elements tuned to that range. A good resource for determining what type of antenna you need (and where to aim it) is the AntennaWeb site. Some people feel that its recommendations tend to be a little optimistic, however, so consider going a step up in gain and directionality from whatever it suggests.

Q. Can I watch HDTV on a regular TV set if I attach an HDTV tuner to it?

A. Yes, if you set the tuner to send the TV a standard-definition (SD) 480i signal. The resulting picture will be very clean, but it will not be high definition.

Q. Do all HDTVs have large screens?

A. HD displays are available in screen sizes as small as 19 inches diagonal, but the difference between HDTV and conventional television will not be nearly as obvious on a small screen as on a big one.

Q. Are all HDTVs flat panels?

A. No--and not all flat panels are HDTVs. It is true, however, that many HDTVs are plasma or LCD panels and that almost all flat-panel sets other than small LCD models are now high-definition. Another big category of HDTVs consists of rear-projection sets (all of which are indeed HD nowadays), most using DLP or LCoS display technology, some LCD, and a handful of traditional cathode-ray tubes, or CRTs. You can also get front projectors based on the same technologies (though there are essentially no CRT-based models available), which project an image across the room onto a screen, as in a movie theater. A very small number of HDTVs using ordinary, if unusually shaped, picture tubes are still available in screen sizes up to 34 inches. The venerable CRT is poised to quit the HDTV field altogether very soon, though, and it is possible that CRT-based TVs of any type, HD or otherwise, will be virtually extinct by the end of the decade.

Q. So what are all these other display technologies--LCD, plasma, LCoS, DLP, and so forth?

A. Let's start with what they have in common. All use fixed-pixel arrays, meaning that instead of adapting the display to the signal (as in a multiscanning CRT monitor), they must adapt the signal to the display. For example, an HDTV native at 1366 x 768 will scale both 720p and 1080i signals to fit all 768 rows of its pixel grid. Some HDTVs also have options for purists to display only 720p without scaling, so there will be 48 "wasted" rows, half on the top and half on the bottom. Most manufacturers default to a full-screen view so consumers won't freak out when they see black bars on the top and bottom of their brand-new TVs.

And all are naturally progressive. Again, this contrasts with CRT-based displays, which can shift between interlaced and progressive modes according to the characteristics of the incoming video signal. (In practice, almost all CRT HDTVs employ just two scanning modes, typically 480p and 1080i, and covert all other video formats to one of those for display.) Finally, all except plasma use filters to obtain the red, green, and blue primary colors used to assemble a color TV picture; plasmas, like CRTs, use colored phosphors.

Q. Since almost all HDTV sets convert all video, including conventional standard-definition broadcast and DVD signals, to their native display resolution, why are HDTV broadcasts and discs necessary? Doesn't the TV make everything that comes into it high-definition?

A. No. It's like pouring a pint of milk into a quart container--the amount of milk doesn't magically double. If an HDTV set does a good job of scaling video to match its own display resolution, DVDs and clean standard-definition broadcasts will look very good, but the pictures will not contain any more actual detail than they would if viewed on a conventional TV. And any flaws in the picture will tend to be magnified, just as you would see when you enlarge a grainy photograph.

Q. So what are the differences among the various non-CRT display technologies?

A. That's a pretty involved story if you get into it, but here's a very abbreviated explanation.

LCDs have pixel cells filled with a liquid-crystal solution (LCD = liquid-crystal display) whose opacity changes according to the electrical current applied to it. Varying the opacity of the pixel cells according to the content of the video signal modulates the amount of light that passes through the panel from lamps behind it. In a flat-panel LCD TV, an array of red, green, and blue filters precisely aligned with the pixel cells provides color. LCD rear-projection TVs, on the other hand, use three small, precisely aligned panels, one for each primary color, bouncing the light that passes through them off a mirror and through a magnifying lens onto the inside of a translucent diffusion screen. And LCD front projectors send the light directly through a lens and out toward a reflective screen.

LCoS (liquid-crystal on silicon) works pretty much like LCD except that it is used only in projectors (front or rear) and places the liquid-crystal arrays on top of reflective surfaces, so that the light bounces off them instead of passing through. DLP (Digital Light Processing) projectors are configured similarly to LCoS models except that the imaging device is a semiconductor chip with an array of hundreds of thousands of tiny mirrors that flip back and forth at high speed under computer control to modulate the amount of light they reflect back.

Like an LCD panel, a plasma display deploys a pixel array across its entire viewing surface. But the pixel cells are filled with an inert gas, and the insides of their front surfaces are coated with phosphors that glow red, green, or blue when hit with ultraviolet light. And ultraviolet light is exactly what the gas emits when it is excited to a plasma state by an electrical charge.

Q. What type of display is best?

A. It depends--on how big a picture you want, where the TV has to fit, the lighting conditions in the room, and your budget. For example, a DLP or LCoS rear-projection set may have performance equivalent to that of a costlier plasma, but the rear-projector set will usually be 16 to 18 inches deep rather than just 4 or 5 like a plasma. And if you definitely want a flat panel but intend to use it in a brightly lit room, an LCD may do better than a plasma even though a plasma might deliver a superior picture in a dimly lit or darkened room. The diagonal of the HDTV should be roughly twice your

expected viewing distance.

Q. When does it make sense to get a front projector?

A. When you want a picture bigger than about 60 or 70 inches and can control the lighting in the room at all times. (You can actually get a flat-panel TV in the 100-inch range, but the prices are astronomical.) If the room is not almost dark, ambient light will tend to wash out the image on the screen. So if you want the kids to be able to watch Spongebob while you read in the same room, forget about it. A front projector can be great for a dedicated home theater, however, creating a genuinely cinema-like experience.

Q. How important is 1080p resolution?

A. Not at all for most people. Unless you're sitting rather close to a very large screen, you likely won't be able to see the difference between 1080p (1920 by 1080 pixels) and a more modest 1366 by 768 or 720p (1280 by 720) display resolution. You would, for example, have to be watching from within about 10 feet of a 50-inch screen to see a difference between 1080p and 720p, or within about 12 feet of a 60-inch screen.

Q. What should I look for when buying an HDTV?

A. Display resolution does matter, up to a point, but it's often oversold because it's so easy to quantify. Other things matter, too--sometimes more. When you know something is supposed to be black, does it look black on the screen, or is it obviously gray? Can you see reasonable detail in dark scenes, or does much of the image get mushed to dark gray or black? How realistic are the colors? And how is the picture when the source is not HDTV? This is important for most people, because most TV still isn't HD, and some sets do a better job of upconversion than others. Look for straight, rather than jagged, diagonal lines and a clean, "quiet" look to the overall picture.

Some of these characteristics may be difficult to assess accurately in a typical store environment, though. The lighting is often harsh, the video feeds are sometimes not the best, and, most important, the TVs on display will usually be adjusted by the manufacturers to stand out in a crowd rather than to produce the best pictures they can. Consequently, your firsthand impressions while shopping may not be completely reliable. Reviews by technically competent writers who take the trouble to adjust the TVs they test for optimum performance can be very helpful in this regard. Even if you can't find a review of a particular model you're interested in, remember that other models in the same family or line are likely to perform very similarly.

Also, consider buying an HDTV that has user-level controls that allow you to control the red, green, and blue color channels individually. These controls are standard on higher-end units, but not always

Q. How much do I need to spend for an HDTV?

A. You can spend anywhere from a few hundred dollars for a very small set to a hundred thousand dollars for a state-of-the-art front projector. Assuming that you're looking for a screen big enough for HD to matter, however, and that your name isn't Bill Gates, you're probably going to wind up spending somewhere between \$1000 and \$5000 dollars--maybe up to \$10,000 at the outside. Although there is not a strict correlation between price and performance (bargains do come along), you can expect that prices will, on average, go up with screen size, performance, or both. Prices are in free fall these days, and that trend is likely to continue given the large number of companies that have jumped into HDTV. You can check out the latest prices at PC World Shopping.

Q. How important are HDMI inputs?

A. It's good to have at least one HDMI (High-Definition Multimedia Interface) input, and two is not a bad idea, since some sources require such a connection to deliver HD signals. A DVI (Digital Video Interface) input can substitute, as HDMI is based on DVI, but make sure it is HDCP-compliant and will accept HDTV signals, not just PC video outputs.

Q. What is HDCP?

A. HDCP, or High-Bandwidth Digital Content Protection, is an encryption and copy-protection standard for digital video signals.

Q. Does it matter if the HDMI inputs conform to the new version 1.3 standard for the interface?

A. Not at the moment. HDMI 1.3 does support wider video bandwidths than earlier versions of the standard, but no current home video source needs that capability to perform to its full potential. Even 1080p sources, such as HD DVD and Blu-ray Disc players, work fine with earlier versions of HDMI.

Q. What is a deinterlacer?

A. A deinterlacer converts interlaced video signals to progressive format. Progressive-scan DVD players, for example, contain deinterlacers to convert the 480i signals on most DVDs to 480p, and all HDTV displays have built-in deinterlacers to convert 480i and 1080i inputs to progressive format.

Q. What is 3:2 (or 2:3) pulldown?

A. It's a technique used in converting film-originated content from its native frame rate of 24 per second (24 fps) to 30-fps interlaced video. Imagine film frames A, B, C, D, and so on. Converting these to interlaced video with 3:2 pulldown yields a field sequence (with two interlaced fields per frame) like this: A1, A2, B1, B2, B1, C2, C1, D2, D1, D2, and so on. When converting such a signal to progressive format, it is important for the deinterlacer to detect and compensate for the staggered cadence, or pulldown, so that it does not create video frames out of fields from different film frames. B2 and B1 should go together, for example, not B1 and C2.

Q. Does a new HDTV really need professional calibration to look good?

A. No, but it almost certainly will need considerable adjustment, whether by you or by a pro. Manufacturers usually ship their sets adjusted to stand out in bright, crowded showrooms rather than to produce the best possible picture in a typical home. On the other hand, most provide picture presets that can at least get you into the ballpark. If there is a preset called something like Movie or Pro, select it, and if there is a color-temperature control, set it to Warm or Low. You can go on from there to adjust the brightness, contrast, and sharpness controls to get a picture that looks good to you. And you can make this process much more efficient and effective if you buy a calibration DVD to assist you. Discs such as Avia, Sound

& Vision Home Theater Tune-Up, and Digital Video Essentials provide special test patterns and instructions on how to use them to set your TV's controls correctly.

If you want to get the very best picture possible out of a new HDTV, however, you should consider hiring a calibrator trained and certified by the Imaging Science Foundation to come to your home and perform all the adjustments, including the ones available on the set's hidden service menu. That will unlock its full potential. Typical price for a full ISF calibration runs from \$250 to \$400. If that seems like a lot, consider that it pays for multiple hours of work; consider also that you've already spend several thousand dollars on a TV you're going to be watching for years to come--don't you want it to produce the very best picture possible? If the dealer from whom you buy your HDTV doesn't have an ISF calibrator on staff, you can find one near you at the Imaging Science site.

Q. Should I get a new DVD player too?

A. Most DVD players that are several years old output only a 480p MPEG2 video stream. This will play just fine on your HDTV, which will scale the 480p signal to fit the pixel grid. However, you may want to consider purchasing a new player that upconverts the 480p signal into 720p and 1080i. This will improve your viewing experience with your existing library of DVD movies.