A Consumer Guide to High-Definition Television

If you’re ready to upgrade your entertainment experience to high-definition TV, you probably already know there’s more to it than just walking into the store and saying, “I’ll take that one.” There’s a whole new vocabulary to learn. There’s new technology to understand, and there are several choices to make. Before you invest in a high-definition television, you need to know what to look for to be sure that the equipment you select will meet your expectations both today and in the future.

This guide will equip you with the basic information you need to move confidently into the future of high-definition TV, answer your questions and explain the technology in non-technical terms.
Choices You’ll Need to Make

Before you buy anything you need to make three choices.

- What will be the source of your HD programming?
- Do you want an HDTV-Capable monitor or HDTV-Ready television?
- What type of display technology is best for your viewing habits and your home?

Selecting the source for your HD programming will directly impact whether you go with an HD-capable monitor or a HD-ready television. There are multiple things to take into consideration before you select the display technology that’s most affordable and best suited for your home. After you read this guide you should visit the Web sites of the HDTV manufacturers, consumer electronics retailers, and cable, satellite and broadcast HD service providers to become even more familiar with what’s available for you.

First, you need some background information to help you make the best HDTV choice.
Standard Definition and High-Definition
Digital TV: The Basics

**DTV (Digital Television)** is a huge leap forward in television technology compared to the analog television that has been widely available since the 1940s.

DTV is delivered and displayed using digital encoding, similar to the way a PC operates. By using digital technology, there is no variation in picture and sound quality from the origination point until it is displayed on your television. You always receive a high-quality picture without the wavy lines or static you might sometimes get from a weak analog signal.

Because DTV receives and displays digital images that contain many times more picture elements (pixels - the small dots that make up the color image on your screen) than standard analog television, you can get a sharper on-screen image than with analog. Additionally, DTV supports multiple-channel, CD-quality sound.

DTV includes SDTV (Standard Definition Television), EDTV (Enhanced Definition Television) and HDTV (High-Definition Television). That means that all high-definition TV is digital, but not all digital is high-definition. A high-definition program must originate in HD and be broadcast in HD. Having an HDTV system does not mean everything you watch will be in high-definition. Getting the signal from digital cable or satellite also does not mean it is high-definition.

**Standard Definition Television** is basic digital television programming delivered by cable or satellite. Typically, the SDTV screen is the same, nearly square shape as an analog television screen. Digital images on an SDTV set are crisp and clear – noticeably better than on a standard analog television set using an antenna to receive over-the-air signals.

**High-Definition Television** is a completely new way to send and receive television broadcast signals. HDTV images are made up of pixels that are much smaller and closer together than those used in standard analog television, and there are millions more of them. Thus, HDTV can display five to six times the detail of analog television to deliver picture quality that is much more realistic, dimensional and precise. SDTV programs can be viewed on an HD television.

Another feature of HDTV is digital surround sound using Dolby Digital®, which is the same technology used to produce the sound you hear in movie theaters.
The Shape’s the Thing: Aspect Ratio

Aside from dramatically improved picture quality and multi-channel digital sound, the most noticeable difference between HDTV and other TVs is the shape of the viewing area which is defined by the aspect ratio.

The almost square aspect ratio that has been used so extensively for decades is 4:3 – the screen is 4 units wide for every 3 units high. By comparison, the HDTV specifications call for the aspect ratio for high-definition viewing to be 16:9, much like a movie theater screen.

While the HDTV standard specifies the 16:9 aspect ratio, not all 16:9 television sets are capable of receiving HDTV signals. It’s important to confirm that the set you are considering will actually receive and display high-definition television. Check the specifications carefully.
Windowpane, Letterbox and the Stretch and Zoom Solution

When you view 4:3 content on a 16:9 HDTV display, you may get an onscreen image with vertical black or gray bars on each side of the image. This is called a windowpane screen.

![Windowpane Screen](image)

Likewise, when 16:9 content is viewed on a 4:3 display, you may see a long and narrow image with the black or gray bars above and below. This is called a letterbox screen.

![Letterbox Screen](image)
**Stretch and Zoom Solution**

One pleasant viewing capability of HD cable set-tops and HD satellite receivers is picture “stretch and zoom.” This enables you to eliminate the black or gray bars and fill your HD screen with a non-HD video image rather than have it squeezed into letterbox or windowpane formats.
Why HDTV Looks So Crisp and Sharp

Understanding what resolution means to picture quality will make you a more savvy high-definition buyer. In television terms, resolution refers to the clarity of the screen image based on the number of pixels on the screen. HDTV is the clear winner on resolution. For example, the image on an older 4:3 aspect ratio screen typically is divided into 480 lines, each with 720 pixels. An HDTV with 1080 lines with 1920 pixels in each line has six times the pixel density.

The image on the screen can be created using two different scanning methods: interlaced and progressive. The “p” or the “i” you see in terminology such as 720p or 1080i refers to the type of scanning used (progressive or interlaced) and the numbers identify how many viewable on-screen lines the TV offers. As the number gets larger, the screen has more lines and more pixels to deliver a sharper, more vivid image.

Interlaced Scanning

On most TV screens anyone has watched for the last 50-60 years, the image is created using interlaced scanning. The lines on the screen are divided into two sections called fields – one field includes the even numbered lines, the other the odd lines. So, each field (the even and the odd) contains half of the image to be displayed.

In rapid succession, all of the odd numbered lines of the picture are painted onto the screen in about one sixtieth of a second, followed by the display of the even numbered lines in the next sixtieth of a second. Each new image is displayed so quickly that your eye is unaware of the process that’s creating the video image.

Progressive Scanning

Instead of combining two fields to display a complete image, progressive scanning treats all the lines as one field and displays them in one sixtieth of a second. This speedy delivery of the entire image on the screen gives a more consistent-looking, clearer picture.
Choosing Your Source for HD Programming: Broadcast, Satellite or Cable?

It seems more HD programming becomes available every day. There are some cost and program availability issues you need to analyze as you select between the three options you have for receiving HD programming.

**Broadcast**

To view HD programming provided by the traditional networks (ABC, CBS, NBC, FOX, PBS, etc.) you need a special antenna and an HD tuner/receiver, but your signal quality may vary based on your geographical location. The most positive aspect of this choice is the programming is free. You will incur costs for an antenna and the receiver. One negative is you are limited to viewing only the programming that the networks select for HD transmission. You won’t have access to specialty HD programming from sources such as HBO, Showtime, ESPN, Discovery Channel, HD-NET, etc. that can be delivered by cable or satellite.

**Satellite**

All of the programs you receive from a satellite service provider will be digital, but not all of them will be HD. In addition to the cost of the standard digital service contract, a charge for local channels (if they are available) and the price of the basic receiver and dish antenna, you may also have to buy a separate HD receiver, install a larger dish and pay an additional fee for HD service on top of the cost for your basic satellite service. This will give you access to HD programming from HBO, Showtime, ESPN, Discovery Channel, HD-NET, etc. The positive is the amount of HD programming you can receive. The negatives are the upfront expense you may incur for all the equipment, HD local content is only available in very limited areas, the long term commitment the satellite service agreement entails and the lack of a local contact if you have any equipment problems.
The digital cable package from your cable company is the starting point for enjoying HD programming from the cable operator. An HD set-top/receiver will deliver both standard digital and HD programs from one device. Your costs will include the price of the digital cable package, the additional cost for access to the HD channels and a monthly charge for the HD set-top which may or may not be slightly higher than the charge for a standard digital set-top. So, as with satellite, you incur some charges for HD service with cable, but because no purchase of equipment is involved, they are likely to be considerably lower than with satellite, and cable does not require a one or two year service agreement for digital or HD service. As with satellite you get all the popular HD programming from HBO, Showtime, ESPN, Discovery Channel, HD-NET, etc. You also get HD programming from your local network affiliates. Check your local cable provider’s web site for details on HD programming availability.

**HD Broadcast Resources**

The major broadcast networks deliver several hours of prime-time programming in HD every week. For the latest information on stations carrying digital programming visit these sites:

- Federal Communications Commission (FCC)

- HDTV Magazines’ site has extensive news items about HDTV and a large list of links to sites where you can find specific HD programming information.
  [http://www.ilovehdtv.com](http://www.ilovehdtv.com)

- National Association of Broadcasters (NAB)
  [http://www.nab.org](http://www.nab.org)
HDTV-Ready or HDTV-Capable?

As you scan the advertisements in the newspaper from your local consumer electronics retailers you may notice a variance of $300-500 for HD products with the same sized screens. Some of that may be attributable to the display technology the units use but more likely it is the result of what an HDTV-Ready television includes that is not available from an HDTV-capable monitor.

HDTV-Ready Television
• Aspect ratio of 16:9 or 4:3 with scanning rates supported of 720p and 1080i, or higher.
• Requires an external HDTV tuner (cable HD set-top or satellite HD receiver) to receive HD programs from cable or satellite. For off-air broadcasts, requires an HDTV receiver and antenna.
• To hear Dolby Audio, you will need a dedicated audio system connected to whichever HDTV receiver you use.

HDTV-Capable Monitor
• Aspect ratio of 16:9 or 4:3 with scanning rates supported of 720p and 1080i, or higher.
• Built-in HDTV tuner is ready for off-air HD signals from a special antenna. To view cable and satellite HDTV programming, a cable set-top or satellite receiver is required.
• To hear Dolby Audio, you will need a dedicated audio system connected to the HDTV-ready television for off-air audio or to the HD set-top or satellite HD receiver for audio.

CableCARD Devices and Digital Cable-Ready Televisions: Another Option

As you shop for an HDTV, you may see some digital cable-ready televisions (DTV) that can receive digital cable service (including HD programming) using a small plug-in card instead of a cable set-top. The CableCARD devices look much like PCMCIA cards used to add modems or memory to laptops.

Before you decide to purchase a TV with CableCARD capability, contact your cable operator to be sure it can provide you with the necessary CableCARD. Current versions of these cards do not support two-way, on demand cable service or an Electronic Programming Guide (EPG). You’ll have to use a telephone connection to receive downloaded EPG information. Development is underway to provide cards that support two-way services.
Use this matrix to help match your HD programming source with the best display.

<table>
<thead>
<tr>
<th>Broadcast</th>
<th>Cable</th>
<th>Satellite</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Requirements</strong></td>
<td><strong>Advantages</strong></td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>Antenna; Built-in HD tuner/receiver to deliver HD channels and Dolby Digital audio</td>
<td>Cable HD digital set-top; Digital cable and HD service</td>
<td>HD digital satellite tuner/receiver and antenna; Standard digital service plus HD service</td>
</tr>
<tr>
<td>No cost for broadcast programming; No need to purchase external HD tuner/receiver</td>
<td>Extensive HD channel availability; Nothing to buy; No long term service agreement; Local channels included; HD video on demand</td>
<td>Some HD channel availability</td>
</tr>
<tr>
<td>Viewing limited to broadcast HD programming; Cost of antenna; Cost of HDTV with HD tuner; Potential signal problems</td>
<td>Requires purchase of basic digital cable service to receive HD programs</td>
<td>May require professional installation and related costs; May require purchase of equipment; Length of service agreement; Availability of local channels; Equipment service</td>
</tr>
<tr>
<td>Antenna; External HD tuner/receiver to deliver HD channels and Dolby Digital audio</td>
<td>Cable HD digital set-top to deliver HD channels and Dolby Digital audio; Digital cable and HD service</td>
<td>HD digital satellite tuner/receiver, Standard digital service plus HD service</td>
</tr>
<tr>
<td>Costs less than HDTV; Flexibility to choose between various HD programming sources</td>
<td>Extensive HD channel availability; No long-term service agreement; Local channels included; HD video on demand</td>
<td>Some HD channel availability</td>
</tr>
<tr>
<td>Requires purchase of external HD tuner</td>
<td>Minimal monthly cost to lease HD set-top</td>
<td>May require professional installation and related costs; May require purchase of equipment; Length of service agreement; Availability of local channels; Equipment service</td>
</tr>
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</table>
Which Type of Display?

HDTVs are available in several types of displays, each with its pluses and minuses. Depending on the method used for displaying the on-screen image, you may notice differences in picture brightness or clarity based on the viewing angle or for other reasons.

Be sure you have a location in your home that is big enough to accommodate the HDTV. Some of the projection models may require a fair amount of floor space. You don’t want to end up putting nose prints on your HDTV because you’re sitting three feet from the screen in a room that is undersized for the set you buy. Also, be aware of where the windows are in the room where you’ll use your new HDTV. The room’s brightness can have an impact on the display type you choose.

These are the primary display technologies you’ll see in stores today:

**Direct View CRT (Cathode Ray Tube)**

This is the familiar TV tube found in most “regular” television sets. It is one of the lower-cost technologies available for displaying today’s HDTV programs. However, because of the weight of the glass tube, these HD television sets are limited to a maximum size of 32 to 40 inches.

**Rear Projection TV**

This is another type of CRT system. In Rear Projection televisions, the image is projected onto a mirror or series of mirrors that reflect the image onto the screen at the front of the set. Rear Projection technology is often the least expensive way to get a larger screen compared with a regular CRT. However, Rear Projection sets get deeper as screen size increases, so large screen models require a lot of space. Viewing angle may affect the perceived clarity of the on-screen image.

**Front Projection TV**

This system has an image source that projects the HDTV signals onto a screen pretty much the same way a projector does in a movie theater. The only factors that limit size in these systems are the amount of light the system outputs, the distance from the projector to the screen and the size of the screen onto which the HDTV images are to be projected.
**DLP (Digital Light Processing)**
This projection display technology is more expensive than CRT projection systems, but not as costly as LCD or plasma screens. Using a digital micromirror device, DLP images are produced by hundreds of thousands of microscopic mirrors, one for each pixel on the screen. This results in razor sharp picture quality and the ability to display very subtle color changes to support over 16 million hues on the HDTV screen. The DLP light engine delivers a bright picture to the screen making this display a good choice for use in a bright room. Pixels are tightly packed to deliver good color and resolution. DLP is a popular choice for a projection display that combines value with performance.

**LCD (Liquid Crystal Display)**
This technology has been used for some time in laptop computer screens. LCDs are flat screens/panels filled with liquid. Each pixel on the screen is lighted individually to produce a display. One strength of LCDs is the picture quality is very consistent even when you are not viewing images from directly in front of the display.

**LCoS (Liquid Crystal on Silicon)**
LCoS is the next step in LCD technology and offers remarkable resolution because several million pixels are etched into each of the silicon chips that make up the display. This superior, concentrated pixel count delivers a great image and enables LCoS displays to be manufactured in much smaller versions for use in portable devices.

**Plasma Displays**
Some larger flat screens/panels use a conductive plasma instead of liquid crystal. These are commonly called plasma displays. Plasma displays are very sleek and thin, making them a hot choice among consumers who say this technology delivers the best color saturation, accuracy and vibrancy.
Screen Size - How Big is “Too Big?”

For optimum viewing you need to match the size of the screen with the dimensions of the room it will occupy and the distance you will need to sit from it.

For HD screens, one manufacturer recommends a “rule of three” for how far to sit from a screen for the best view. Multiply the height of the 16:9 HD screen by three for the best viewing distance. Surprisingly, with HDTVs, you’ll discover that you actually need to sit closer than you think for the best view.

Use these general guidelines for 16:9 aspect ratio screens:

<table>
<thead>
<tr>
<th>Screen Size (Diagonal/Height)</th>
<th>Optimum Viewing Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>30&quot;/14&quot;</td>
<td>4 Feet</td>
</tr>
<tr>
<td>40&quot;/19&quot;</td>
<td>5 Feet</td>
</tr>
<tr>
<td>50&quot;/24&quot;</td>
<td>6 Feet</td>
</tr>
<tr>
<td>60&quot;/29&quot;</td>
<td>7 Feet</td>
</tr>
</tbody>
</table>

Use a combination of these optimum viewing distances, the type of HD display you have decided upon and the size of the room you plan to use as helpful guidelines for selecting an HD display that is best suited for your home.
More Screen Considerations

Another factor in your decision on display technology is the way you will be using your television set. If you play a lot of video games or spend a lot of time watching channels where text and graphics stay in the same location on the screen for quite a long time, you may want to choose an LCD, DLP or LCos display. Static images may be “burned in” on plasma and CRT-driven rear-projection screens, leaving a faint, but permanent impression of the image on the screen. Many manufacturers have developed technology to overcome this problem so be sure to ask before you buy to see if this has been addressed in the model you select.
A Few Words About HDTV Connectors

You’ll need to become familiar with the three most common inputs for HDTV that you will come across in your search for the display best suited to fit your needs.

These HDTV connectors maximize your viewing experience:

Component Video

Using a three plug video connector, component video delivers the best viewing experience by supporting superior color details, improved color purity, and a reduction in the impact that interference or other poor signal quality issues may have.

Digital Visual Interface (DVI)

DVI connectors transfer video signals in pure digital form, which is especially beneficial if you’re using a plasma, LCD, or DLP TV. Signals are encrypted with HDCP (High-bandwidth Digital Content Protection) to prevent recording. There are two types of DVI connectors - DVI-D carries digital-only signals and DVI-I passes both digital and analog video signals. Some TVs feature DVI-I inputs for greater hookup flexibility.
High-Definition Multimedia Interface (HDMI)

An HDMI connector supports an all-digital link between an HD cable set-top or satellite receiver that combines digital video and digital audio on one connection rather than using separate connectors for each function. This delivers extremely high-quality digital video and audio. HDMI is fully backwards compatible with DVI.
Wrapping It All Up: Before You Buy, Ask Yourself…

**Is HD programming available via off-air broadcasts, cable or satellite in your area?**

You may want to go with digital cable or satellite service via an SDTV or EDTV if there is no HD service in your area. Use the links in the “Over-the-Air Broadcasts” section to search for HD service in your area or consult your cable or satellite service’s Web page.

**How will you receive HD service – off-air broadcasts, cable or satellite?**

Broadcast-only HD will limit you to whatever programs the networks choose to transmit over the air in HD. Cable and satellite service will deliver the networks’ broadcast HD programs (assuming your satellite service delivers local broadcast stations), plus any cable or satellite network HD programming available.
Do you want an HDTV-capable monitor with its built-in HD receiver or an HDTV-ready television and an HD cable set-top, satellite receiver or other external HD tuner?

The HDTV-capable monitor will probably cost more than the HDTV-ready television. If your HD service is going to come via cable or satellite, you’ll still need the HD cable set-top or satellite receiver to get HD programming on your HDTV. So, you may be able to save some money by buying an HDTV-ready television and accessing HD programming via an HD cable or satellite hookup.

Does the HDTV-capable monitor or the HDTV-ready television support 720p or 1080i scanning?

Both scan rates support HD programming. Your TV must support one or the other.

How do I choose the right screen/display for HDTV?

Shop around a lot. Do some research at the HDTV manufacturers’ web sites BEFORE you go into the stores. Seeing the unit in action is probably the best way to make your choice. Stand in front of the unit and note the picture clarity. Then, walk to the left and right to see if the image clarity changes. Your budget will also play a big role in the product you buy.
You’re Ready for the Final Step

Now that this overview has taken much of the mystery out of HDTV, you’re ready to make your choices. Think about how much more you know now about HDTV than you did before you read the preceding pages. Because you’re better informed, the jargon of HDTV will make more sense when you do more research online or visit a consumer electronics store. And, most of all, remember that you’re in charge when it comes time to make your final choice. Weigh all the factors and rely on what you know. Then, sit back, relax, and get ready for the thrill of the most realistic, enjoyable video and audio home entertainment experience you’ve ever had.
Clearly
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