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What do you want to learn about Projection TVs 40 inches and up?
Basics GO

HDTV Basics

HDTV: The Future of TV Has Arrived

If it's true that we Americans love watching TV (perhaps more than we should) it stands to reason that any improvements as drastic as those HDTV brings are big news. This is not a far-off future technology; HDTV is here now. Many of you have already seen some of your favorite TV shows in HDTV. As for the rest of you, this superior audio and visual experience will soon become a reality.

Picture

The most obvious improvement HDTV offers is a very clear, sharp picture. HDTV has the ability to give you a picture like you've never seen on television. About the closest most of us have ever gotten to picture quality this good is a really good photograph. Many people have said that looking at a program in HDTV is like looking out a window. You don't have to know all the technology behind it to see that it's a vast improvement--HDTV is up to 10 times sharper than anything you've seen on your TV to date. Ten times!

Presentation

In addition to looking great, you'll notice that some HDTVs sport a wider-than-normal screen. The screens on the TVs most of us are still watching today (referred to these days as "analog" or "traditional") are roughly square and have an "aspect ratio" of 4:3. That is, they're just slightly wider than they are tall. But widescreen HDTVs have an aspect ratio of 16:9. As you can see, they're much wider than they are tall. So, what's the advantage? We thought you'd never ask.

Surely you've noticed that movies shown at a theater have pictures that are wider than your TV's screen. By the time a movie is released on video tape or shown on TV it has been "modified to fit your screen." Unfortunately, they "modify" it by chopping off the sides of the picture. Widescreen TVs use the entire TV screen to let you see the whole picture.

Sound

Another advantage of HDTV is the sound quality. Remember the first time you heard a CD? Compared to the records and tapes you were used to, it was like you were in the same room with the musicians. And compared to FM radio? Well, there was no comparison. The sound coming from your TV is FM. The sound you'll get from HDTV is, of course, digital, just like CDs.

So that's HDTV in a very small nutshell. It promises to revolutionize the way we watch our favorite programs and give us picture and sound quality you've only seen in movie theaters. HDTV is here now, and we'd love nothing more than to show it to you. Come on by a Circuit City store near you and see what all the buzz is about.

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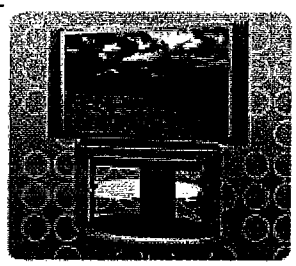
Discovery HD Theater redefines HDTV

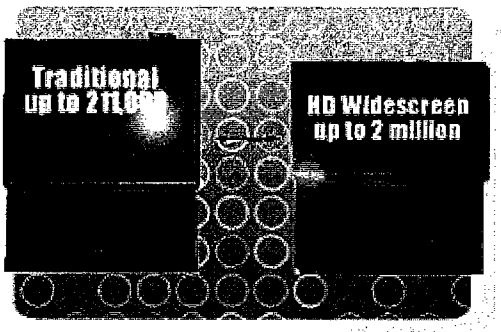
Rediscovering TV:

Circuit City & Discovery HD Theater are bringing the world into focus

Circuit City and Discovery HD Theater have teamed up to bring the world around you into clear view. Discovery is redefining the way we experience TV with its new 24/7 high-definition channel, Discovery HD Theater. And with Circuit City's impressive selection of HDTVs, plugging in to the most vibrant programming ever is easier—and more rewarding—than you could imagine.

Discovery HD THEATER





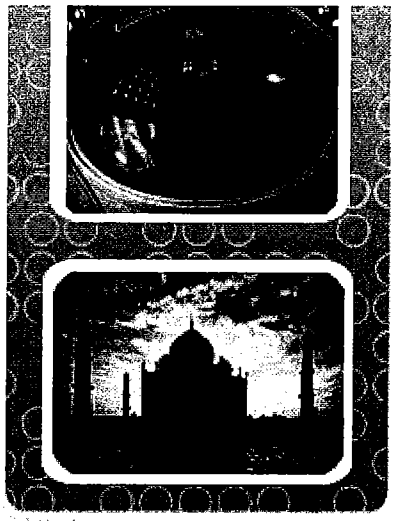
what's the big deal about HDTV?

You may have heard high-definition TV described in a number of ways. Maybe you've heard it described in numbers—it features 10 times the number of pixels as standard TV, up to 1080 lines of information and 5.1 Dolby surround sound. Don't worry, we'll explore this technology further later on. Then there's the anecdotal praise you've probably heard from friends: HDTV is more clear and vibrant than anything you've seen, it's lifelike, amazingly real, and the sound is just as striking as a DVD. And while all these descriptions are true, it cannot be denied that seeing is believing. **Stop by your local Circuit City to get taste of HDTV and a tease of Discovery HD Theater's exciting new programming.**

high definition, higher adventure...

The Discovery Channel has made its name by taking us to destinations that we could never venture to on our own—they've taken us back in time millions of years to explore ancient landscapes and stalk prehistoric animal life, and they've invited us to look under the hood and ride shotgun with today's hottest celebrities in their hot and trendy, tricked-out rides. And when you explore the world in high

definition, it's the closest thing to being there.



Discovery HD Theater draws on some of Discovery's most popular programs from its series of engaging channels. Come face-to-face with fierce wildlife in "**The Jeff Corwin Experience**" then tool around with the hit home improvement show with a twist, "**Trading Spaces**." Explore nature, geography, world cultures and lifestyles, health, science and technology—and experience it all with the most vibrant picture and clearest sound.

So now that you have this ground-breaking high-definition channel, how are you going to take it all in? That's where Circuit City comes in. We have HDTVs in the size, shape and style you're looking for at the prices you want. And we have all the right learning resources to help you make smart buying decisions. Plus, it's all a cinch to set up.

get connected

To make the jump to HDTV and saddle up with **Discovery HD Theater**, you're going to need an HDTV, and you have two options: an HDTV or an HDTV monitor. True HDTVs have the high-definition receiver that's required to display HDTV broadcasts already built in. HDTV monitors are ready for HDTV when you are—all you have to do is add the receiver. TVs can pick up the actual high-definition signals in the same manner by which they pick up standard TV signals—over the air with an antenna, but this will only give you access to local channels. In order to watch cable or satellite programming in high definition, you'll need to contact your local provider. Satellite TV viewers will need an HD-ready satellite receiver and cable subscribers will require a special converter box to view HD programming. Once you have your HDTV hooked up and ready to go, you just need to order **Discovery HD Theater**—the amazing 24-hour all high-definition channel is a subscription service.

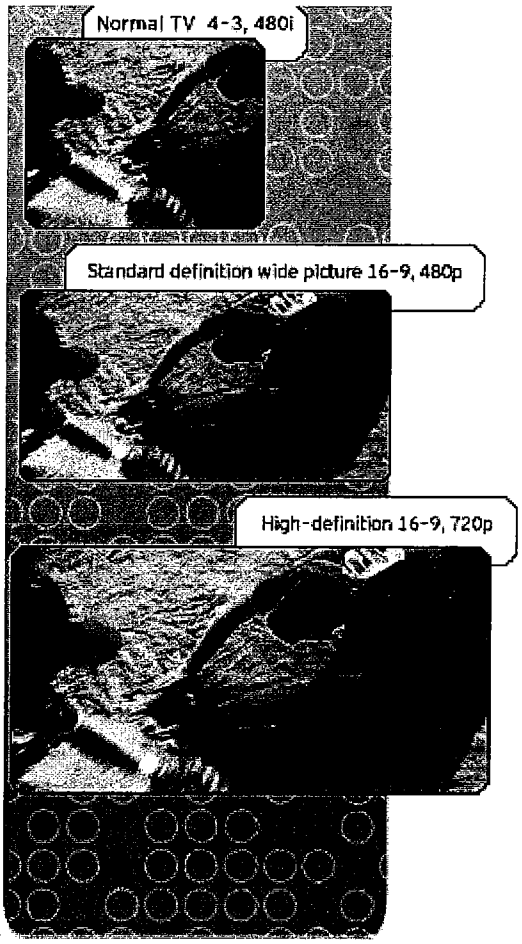
HDTV dissected

If you were to take a look under the hood of HDTV, you'll quickly find out that high-definition isn't just a substantial upgrade from standard TV broadcasts—many of high definition's measures of picture quality are double that of standard TV. That's because compared to the limitations of a traditional analog signal, the amount of information you can fit into a digital signal is enormous. This increased "room" lets broadcasters provide vastly improved picture and sound quality. Like we said in the beginning, the most obvious improvement HDTV offers is a very clear, sharp picture. Many people have said that looking at a program in HDTV is like looking out a window. There are many features that account for this unsurpassed quality, including:

• lines of resolution / pixels

While lines of resolution are one of many good indicators of a traditional TV's clarity, HDTVs are measured a bit differently. A

TV picture—any TV picture—comprises little dots of color called pixels. Like a mosaic, the more pieces, the better the picture. Traditional TVs have as many as 211,000 of these little dots, but HDTVs and monitors have as many as 2 million—that's nearly ten times more! It's pretty easy to see why HDTVs look so good.

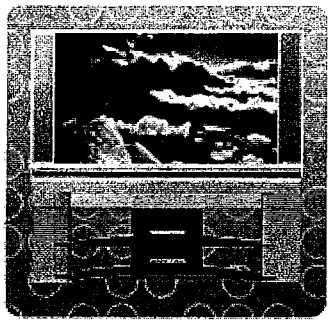


• horizontal scan lines

The pictures that you view on traditional TVs are made up of 480 horizontal scan lines. These 480 lines are put together in an odd-even pattern called interlacing. First the odd lines of the picture are placed on the screen (1, 3, 5, etc.) and then the even lines (2, 4, 6, etc.). This process is done continually and so quickly (30 complete frames every second!) that we perceive them as full motion. The other way to craft a picture on a screen is called progressive scan, and it's found only on HDTVs and HDTV monitors. Only digital broadcasts and sources such as DVD players send a signal this way. Similar to computer monitors, progressive scan creates a picture by scanning the lines in order, all lines at the same time (1, 2, 3, etc.). Not only does HDTV use this superior method of creating a picture, but it uses a whopping 720 horizontal scan lines in progressive-scan format (a standard known as 720p) and 1080 lines in interlace format (1080i)—far more than traditional TV.

• widescreen design

HDTVs sport a wider-than-normal screen style that's known as widescreen. The screens that most of us are still watching today are roughly square and have an aspect ratio of 4:3. That is, they're just slightly wider than they are tall. But widescreen HDTVs have an aspect ratio of 16:9. As you can see, they're much wider than they are tall. You may have noticed that movies shown at a theater have similarly sized screens. The advantage is that this 16:9 ratio mimics our field of vision—it feels more natural and lets you see more. By the time a movie is released on videotape or shown on TV it has been "modified to fit your screen" unless you buy the widescreen (letterbox) version. Unfortunately, this modification includes chopping off the sides of the picture. Widescreen TVs use the entire screen to let you see the whole picture.



The choice is clear, and so is the picture. A slick new HDTV and the breath-taking programming available through Discovery HD Theater are an amazing match. Almost. All that's missing is you staring in awe at the world around you displayed incredibly on nearly 2 million radiant pixels. That's Discovery HD Theater.

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HDTV FAQ

HDTV Frequently Asked Questions

What's the big deal about HDTV?
HDTV is the first big thing to happen to television since color was introduced over 40 years ago and may even be more important. Many HDTVs have wide screens that let us see movies like we saw them in the theater, and all of them are capable of a picture that's literally ten times sharper and clearer than the picture we're looking at today. And then there's the sound that is as clear as any CD you've ever heard. Make no mistake, HDTV has the potential to change virtually every aspect of our favorite diversion

What's the difference between an HDTV and an HDTV monitor?
While both HDTVs and HDTV monitors must be able to display high-resolution 720p (720 lines of information in progressive scan format) and 1080i (1080 lines of information in interlace format) pictures, true HDTVs already have the high-definition receiver built in. HDTV monitors are ready for HDTV when you are-all you have to do is add the HDTV receiver.

Why are TV broadcasts switching to high definition?
We Americans love technology so much that we were the first adopters of a broadcast standard way back in 1937. But being first also means we have the oldest system available. And you can't just change broadcast standards whenever you want to because that requires everyone to buy new TVs. This is not something most people like doing too often.

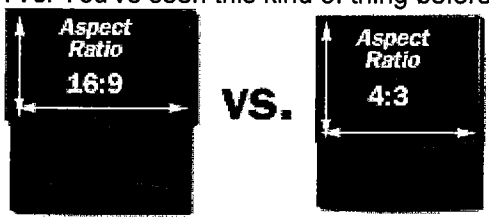
So here we are, over almost 65 years after we met TV for the first time, finally updating the system that brings TV into our homes. The question is what are we going to gain from this change?

The short answer is that high-definition TV provides picture and sound quality most people have never seen or heard before. The more specific answer is that HDTV shows you pictures that are unbelievable, bordering on three-dimensional. The sound is not only as good as a CD, with the right kind of equipment you'll be able to hear your favorite TV shows and movies in one of the most sophisticated types of surround sound available--Dolby® Digital.

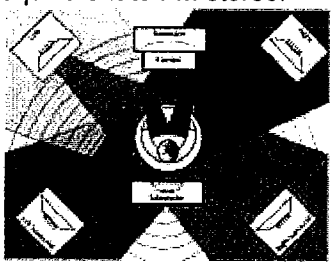
What can HDTVs do that traditional TVs can't?
Compared to the limitations of a traditional analog signal, the amount of information you can fit into a digital signal is enormous. That increased "room" lets broadcasters provide vastly improved picture and sound quality. The most obvious improvement HDTV offers is a very clear, sharp picture. It has the ability

to give you a picture like most people have never seen on television. High definition images are about 10 times sharper than the pictures we're used to. Many people have said that looking at a program in HDTV is like looking out a window-a really clean window!

- **A note about widescreens** As you begin to look around at HDTVs or HD monitors, you will begin to notice that many of them a lot wider than they are tall. These are appropriately called widescreen TVs. You've seen this kind of thing before--in fact, that last movie you saw in a theater looked a lot like this. Widescreen TVs let you see movies as they were meant to be seen because their screens are shaped more like movie screens. And when you're watching a regular TV show, broadcast in the standard, square-ish format, the TV doesn't use the sides of the screen. Either way, you'll see everything there is to see no matter what you're watching.



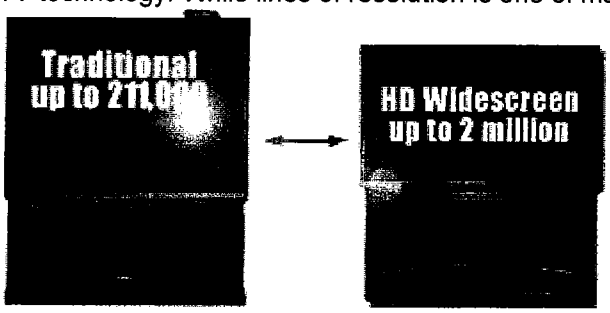
- **Digital Sound** The improved sound quality has two levels: digital, CD quality sound and digital surround sound. Right now, traditional analog TVs give you sound that is equivalent to FM stereo. HDTV broadcasts deliver digital sound comparable to CDs--just hook the TV up to your stereo and enjoy. That means clearer dialogue and more dynamic music, which makes watching TV a lot more fun.



The next level of the improved sound quality issue is that HDTV broadcasts are able to send signals in a type of surround sound called Dolby® Digital, which doesn't just sound great, it has the ability to create surround effects in your family room you've only heard in a theater. The kind of home theater surround sound most people have heard (Dolby® Surround or Dolby® Pro Logic) creates surround effects out of four or five speakers using only 3 channels of sound. Dolby® Digital uses a format called 5.1, so named because there are five separate channels of sound and one channel just for low frequency effects. The result defies description but the first time you hear it you'll understand what all the fuss is about

Will everything look and sound this good on an HDTV or HDTV monitor?
There is a misconception that anything broadcast in HDTV will have movie-quality clarity. The truth is that any broadcast is only as good as the source material. In other words, "I Love Lucy" broadcast in HDTV will still look like a black and white show from the 1950s. It'll look better than it would on a traditional TV, but HDTV can't improve on the original material, only make it look its best.

How many lines of resolution is an HDTV capable of?
The fact that you're interested in learning the answer to this tells us that you know a little something about TV technology. While lines of resolution is one of many good indicators of a traditional TV's clarity, HDTVs and monitors are measured a bit differently. A TV picture--any TV picture--is made up of little dots of color called pixels. Like a mosaic the more pieces, the better the picture. Traditional TVs have as many as 211,000 of these little dots, but HDTVs and monitors have as many as 2 million. It's pretty easy to see why HDTVs look so good.



Why do some HDTVs have a wider screen?
Some HDTVs and monitors have a screen that is significantly wider than it is tall. These widescreen TVs use the entire screen, letting you see movies just as you would see them in a theater. Right now, traditional TVs give you two options when renting or buying a movie: use your entire TV screen or see the entire picture without using the entire screen. The first option makes a movie frame fit on a traditional TV by simply chopping off the sides of the picture. This works fine most of the time, but occasionally you'll notice that the camera seems to move awkwardly to include the missing actors or scenery. This process is called "pan and scan" and you'll often notice it when there is a close-up of two or more people talking and they can't both fit on the screen at the same time.


Standard NTSC Broadcast

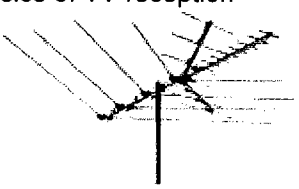
The other option is called letterboxing. Letterboxing allows you to see a widescreen picture on a traditional 4:3 TV by simply not using the top and bottom of your TV's screen. Once you get used to the initial shock of not seeing a picture on the whole TV you begin to see why directors prefer this format-there's stuff on the sides of the picture that a square screen could never show you.

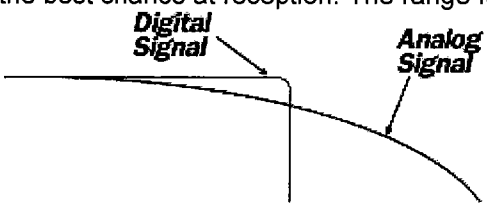
If you don't like the idea of having to choose between seeing the whole movie and using the whole TV, there is now a third option: widescreen HDTVs and monitors. These TVs give you the best of both worlds because they let you see the entire movie picture by--you guessed it--using the entire screen.

So what happens when you want to watch a good ol' square-shaped TV program on an HD widescreen TVor monitor? These TVs use a kind of vertical letterboxing that doesn't use the sides of the screen.

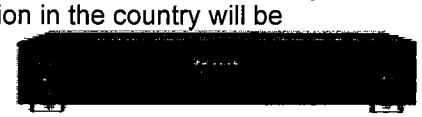
How will I receive HDTV?
Right now, there are three possible ways to receive HDTV programming: an antenna, either roof-mounted or set-top; DIRECTV satellite system; and, in a small but growing number of markets, digital cable. Understandably, an antenna is the method with the fewest compatibility issues because it's by far the most straightforward.

It may have been a few years since you've had an antenna on your roof, but the basics of TV reception haven't changed all that much. Directional antennas, ones that can be turned to face the broadcasting tower, that are mounted as high as possible will give you the best chance at reception. The range for an HDTV broadcast is currently about 35-45 miles. Unlike traditional analog signals, the quality of the HDTV signals doesn't deteriorate over distance. It used to be that if you were on the fringes of the reception area for a TV signal, the picture you got was pretty poor. Unlike traditional signals, digital is an all or nothing medium; either you get the signal and it looks and sounds great or you get nothing.



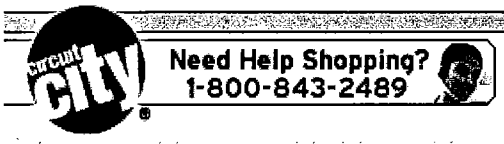


What about the TV I have now?
This is understandably the most asked question about HDTV, and we have good news for those of you who aren't ready to buy a new TV anytime soon: you don't have to. Every station in the country will be broadcasting traditional TV signals until at least 2006 and possibly well beyond. Even after traditional signals are no longer available, there will be receivers that will allow you to receive an HDTV signal on your traditional TV. It'll still look like analog TV, but you'll be able to get all your favorite shows. Also, the coming of HDTV broadcasts will not have any effect on your ability to watch your VCR or DVDs.



What about my VCR and/or DVD player?
Whatever happens to TV broadcasts in the future, video sources like VCRs, DVD players, and laserdisc players will work just fine on your existing traditional TV. So don't worry, none of this changeover to HDTV broadcasts will stop you from watching your tape of that last "very special" episode of "Blossom." It's worth noting, though, that your traditional analog VCR will not be able to record HDTV broadcasts without the aid of a receiver that can receive and "down-convert" HDTV signals.

What will happen if I buy a traditional TV today?
Every TV in existence will work exactly like it does today until at least 2006 and probably longer. What happens then? Once TV signals go all digital, you'll be able to get a receiver that will convert the HDTV signals your TV can't make heads or tails of into analog signals. Your TV shows won't look any better than they do now, but they'll still be there.



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HDTV Glossary

HDTV Glossary

In the coming months and years, you will begin to hear many terms used to describe this new digital television technology. Here are some common industry terms defined in non-technical terms.

3-Line Digital Comb Filter - Provides ultra-high resolution (picture sharpness) and eliminates picture artifacts such as dot crawl and shimmer. We include variations that provide similar picture quality within our specifications, such as 3-D Digital Comb Filter, and 3-Line Digital Y/C Comb Filter.

3:2 Pulldown (3:2 Film Correction) - The moving pictures you see on a movie screen are actually a series of still images flashing by at a rate of 24 frames per second. The images you see on TV are created at a rate of 30 frames per second. This discrepancy in the frame rate can create some problems with showing a movie on TV-whether from a broadcast, videotape, or DVD. The picture may look smeared and the action may look jittery and stuttering. Many high-definition TVs and monitors have circuitry that's designed to eliminate these artifacts and give you a crisp, clear picture without any distractions.

1080i/720p Capable - These two formats are the definition of High Definition. The analog signals we're all used to use 480 lines of information to create a picture, and those lines are scanned onto the screen in an odd-even pattern called interlace scanning. This standard is called 480i. High definition signals, on the other hand, create pictures using either 1080 lines of information, interlaced, or 720 lines of information in a format called progressive scanning. (See Progressive Scan/Line Doubling)

Analog Comb Filter - Without a comb filter, a TV set cannot do a very good job of separating the color and black and white signals. This limits basic TVs to about 250 lines of resolution, or sharpness. A basic analog comb filter provides at least 330 lines of resolution and sometimes more.

Advanced Television Systems Committee (ATSC): The group who sets the standards for digital TV, both high and standard definitions.

Analog TV Broadcast (also known as NTSC): A video signal in the form of a wave that constantly changes shape as color, brightness, and motion within the video image change. We will be referring to this as a traditional signal or picture.

Artifacts: Unwanted elements in the video image resulting from video signal transmission.

Aspect Ratio: The ratio of picture width to picture height. May be like a movie screen (16:9), or like a traditional TV (4:3).

Bandwidth: The path size for digital or traditional information to flow. The improved compression used with digital signals allow for more and varying types of information to be sent and received simultaneously.

Channel: Bandwidth section of the broadcasting spectrum allocated for digital or traditional broadcasts.

Component Video: A type of connection usually marked by red, green, and blue jacks that uses three RCA cables to carry the luminance (brightness) and chrominance (color) signals components of a color video signal.

This type of connection is becoming more common all the time and yields a better picture than even S-Video connections.

Composite Video: A traditional video signal that includes the luminance (brightness) and chrominance (color) signals in a single wire.

Compression: A manipulation of digital data that reduces the amount of picture information without noticeably degrading picture quality. Compression allows higher quality pictures to be transmitted in the small channel space currently used by traditional TV broadcasts. It will become a more useful feature when digital technology allows broadcasters to send both data and images of the same object simultaneously, such as statistics on the opposing team's quarterback while a play is in motion.

Datacasting: Transmission of data to your television through a portion of the bandwidth not used by video information. This digital feature is not yet available.

Digital Comb Filter - See Analog Comb Filter. It converts color, and black and white picture information to digital information, and does a very effective job of separating them. It provides better picture sharpness with less color artifacts and shimmer than on standard or analog comb filter sets.

Digital TV (DTV): A technology that transmits information as ones and zeros as opposed to transmitting the information in wave form. The digital signal is read by a digital TV much like a computer.

Digital TV Receiver: Gathers and translates digital information into a form understood by a digital TV. This will also act as an ATSC (digital) tuner on your traditional TV set.

Digital Video Interface (DVI): This port is a digital interface for connecting a video source, such as a DVD player and other HDTV components, to an HDTV or HDTV monitor. DVI has the necessary bandwidth for uncompressed, HD digital video and transmits a digital stream of up to 5 Gbps.

Dolby Digital®/AC3: Digital audio with five channels of sound (center, front right, front left, rear right, rear left) plus a subwoofer channel.

Down-convert: Converting a higher resolution format signal into a lower resolution format signal (e.g., a 1080i input to a 480p display).

Federal Communications Commission (FCC): The government agency that mandates what broadcast formats are to be used. It approved the digital format and applied the 2006 date for total compliance.

FireWire: The standard interface for the transfer of high-speed digital data between devices such as a digital TV receiver and a digital VCR. May also be referred to as IEEE 1394 and "i.link."

High Definition: The most recognized format of digital television, which provides the clearest, highest resolution picture. Often called 1080i or 720p.

HDTV: Otherwise known as High Definition Television, HDTV ties together the clarity of digital TV and the superb quality of Dolby Digital Surround Sound for the ultimate entertainment package. HDTV offers 720 to 1080 lines of resolution, and as many as 2 million pixels; analog only brings 480 lines to the viewing screen, and no more than 211,000 pixels. In terms of hardware, an HDTV refers to units that include both the high-definition receiver and the viewing screen.

HDTV Monitors: These are TVs that can display digital TV signals once they are connected with separate high-definition receivers.

Interlaced Scanning: A video image consists of multiple frames. Frames are multiple lines of video put together so closely they appear as a solid picture. Interlaced scanning fills in odd lines, then the even lines, to produce a frame of video.

Letterbox: The black bars that appear either on the top and bottom or sides of a TV screen. This happens when the broadcast format is different from the display format. For example, for a movie is broadcast in 1080i (widescreen), black bars will appear on the top and bottom unless you are watching the movie on a HD widescreen set.

MPEG-2: The digital compression standard developed by the Motion Picture Experts Group that allows data to be sent with images in a small path.

Mode: A setting on the digital TV receiver and digital television that allows you to display the correct broadcast/display format.

Multicast: The simultaneous transmission of multiple programs on one digital TV channel. This represents a future capability of digital.

NTSC (National Television Standards Committee): Group responsible for approving the traditional broadcast standard still being used today.

Pixel: A picture element. The single point of color in a video image. The more pixels, the better the picture appears.

Progressive Scanning: A video image consists of multiple frames. Frames are multiple lines of video put together so closely they appear as a solid picture. Progressive scanning fills each line consecutively (e.g. 1,2,3,4) until the frame is complete.

Resolution: The number of pixels in a video image. The greater the number of pixels, the higher the resolution.

Set-top box: See "digital TV receiver."

Simulcast: Broadcasting the same program on two different channels or frequencies. The FCC is mandating that all broadcasters simulcast in digital and traditional formats until 2006.

Standard Definition: A digital format of 480p. With the help of a digital TV receiver, a standard-definition television can receive a high-definition signal (1080i) and display it on a 480p format (DVD quality). Today's traditional TVs display a format of 480i.

S-video: Keeps luminance and chrominance signals separate. Alloys you to connect a DirecTV system, DVD player, or other video source with S-video outputs directly to the luminance and chrominance circuits of the TV. This yields a picture free of color artifacts.

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HDTV Technical Details

HDTV Technology

In 1996 the FCC finally approved not one but 18 different resolution standards, although there are four that seem to be the ones that will inhabit the airwaves for the foreseeable future: 480i (regular analog TV), 480p, 720p and 1080i. These standards designations are made up of two components: the number of horizontal scan lines and how the picture is "drawn." The designation 480i, for instance, is telling us that the television picture is made up of (approximately) 480 lines of information called horizontal scan lines. The "i" indicates that the picture is being put together by a process called interlace scanning. The designation 480p, on the other hand, indicates the picture is put together using progressive scanning.

Horizontal Scan lines

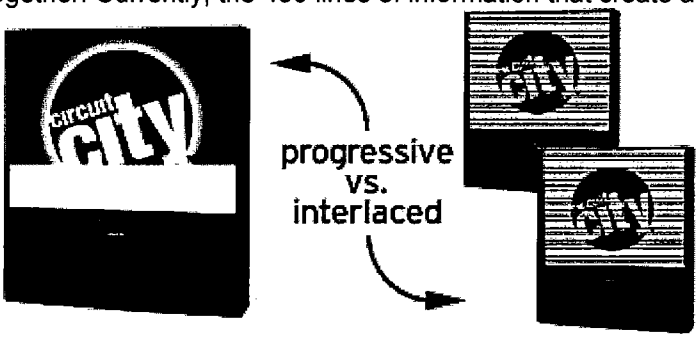
Right now, the pictures we see on our traditional TVs are supposed to be made up of 525 horizontal scan lines*. But since some of those lines are used for things other than the picture, the truth is that the total is closer to 480 horizontal scan lines, which is why the standard is called 480i and not 525i. Regardless of the source-DVD, laser disc, antenna or satellite, or VCR-the picture most of us look at today is always made up of about 480 lines of information.

We, and all the other countries who signed up for the first color broadcast standard (NTSC) back in 1953, have been limited to looking at the same 480 horizontal scan lines for over 50 years even though better technology has been available for decades. High-definition HDTVs and HDTV monitors (which require a separate set top box to receive HDTV broadcasts) are able to show images with 720 and 1080 horizontal scan lines.

Now that you know what all the numbers mean, let's look at what the letters are all about.

Interlaced vs. Progressive

This refers to the way in which the TV picture is put together. Currently, the 480 lines of information that create a picture on your TV screen are put together in an odd-even pattern called interlacing. First the odd lines of the picture are placed on screen (1, 3, 5, etc.) and then the even lines (2, 4, 6, etc.). This process is done continually and so quickly (30 complete frames every second!) that we perceive them as full motion. The other way to "paint" a picture on a screen is a method called progressive scan, and it's found only on HDTVs and HDTV monitors because only digital broadcasts and sources like DVD players send a signal this way.



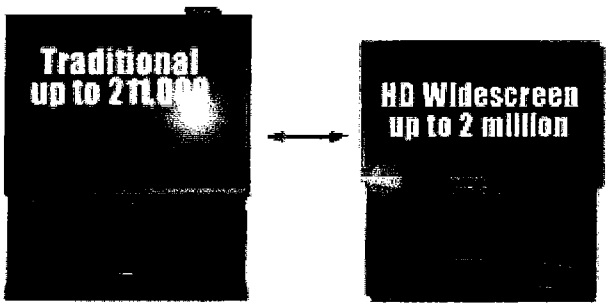
Like computer monitors, progressive scan creates a picture by scanning the lines in order, all lines at the same time (1, 2, 3, etc.). The way the picture is created is just one factor that determines picture quality. But that one factor is a big deal when it comes to DVD players. You see, more and more DVD players have progressive scan outputs that are designed to connect to an HDTV or HDTV monitor. You think you've seen DVD at it's best? Wait 'til you see your favorite movies on an HDTV with a progressive scan picture. Wow.

Pixels

Pixels is short for "picture elements" and they're the little dots of color that make up a TV picture. In fact, one really close look at a picture in a newspaper or magazine will show you how enough dots can create a picture.

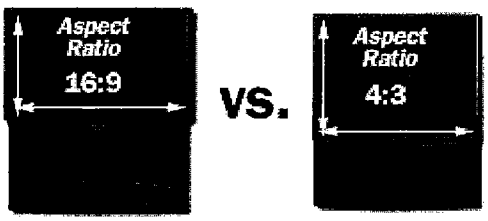
Of course, there's a pretty big difference between the picture quality of a picture in a magazine and a color picture in a newspaper. One of the reasons for this is the number of dots that make up the picture. You have to look pretty closely at a magazine picture to see that it's made up of tiny dots, but the dots in a newspaper picture are much more obvious-in part because there are fewer of them. The point of this little experiment is that the more dots (or pixels on a TV screen) that make up the picture, the clearer and sharper the image.

The current traditional TVs make a picture using up to 200,000 pixels. That's a lot of little dots, but this is one of those rare instances where more is just plain better-widescreen HDTVs and HDTV monitors have up to 2 million. Those extra pixels are capable of creating a picture that's ten times sharper than any TV picture you've ever seen. If you think of traditional TVs as being a newspaper picture, and HDTVs and monitors as a photograph in a magazine, you'll have a pretty good idea of how they compare.



Digital and HD widescreen TVs offer higher resolution than traditional sets.

Aspect Ratios
Today's traditional TVs are roughly square. If you were to express their shape using a ratio it would be 4:3; it's a little wider than it is tall. When you go to the movies you may have noticed that the screen is significantly wider than it is tall, and that's expressed as 16:9. You may have also seen a 16:9 picture on your current TV in a format called letterbox.



Letterbox lets you see a widescreen picture like you'd see in a movie theater on your roughly square TV by using the entire width of the screen, but not the entire height of it. This leaves you with black bars on the top and bottom of the screen, but more importantly it lets you see the whole picture. It should come as no surprise that movie directors are wild about the letterbox format because it is the only way you will ever see the picture they wanted you to see on your 4:3 TV. For this reason, some videotapes and virtually all of the DVD movies you can buy or rent offer the letterbox format.

Many HDTVs and HDTV monitors have wider screens that can use the entire screen to show widescreen movies and TV shows (without the black bands!).

A word about sound The phrase "CD-quality sound" is overused these days, for sure, but it's absolutely accurate when it comes to HDTV broadcasts. The sound you're used to from your analog TV is broadcast just like FM radio. Remember the first time you heard music on CD? Compared to the records and tapes you were used to it was like the musicians were in the room with you. Just wait 'til you hear how much better movies, music, and your favorite TV shows sound with a digital audio signal**.

In addition to sounding clear, some HDTV broadcasts will carry audio signals in a surround sound format called Dolby® Digital. With the right home theater equipment, Dolby® Digital can recreate surround sound effects from five different speakers in a dizzying array of combinations. This means that Dolby® Digital is capable of convincing your ears that a bullet is coming from the front left, whizzing by your head on its way to the left corner of your room. Or, if you prefer less violent fare, it can convince your ears that you're in a forest and the cricket you hear is behind you to your right.

Digital Video Interface
Digital Video Interface (DVI) is a port by which a single DVI cable connects a video decive, such as a DVD player or other HDTV component, to an HDTV or HDTV-ready TV. This connection is important to HDTV picture integrity because DVI supports HDTV's high-resolution video. These visual capabilities are far superior to analog interfaces, such as Composite video, S-video, and even Component video, and can bring you visual performance unlike anything available before.

DVI has been widely supported and adopted by the TV industry as the ideal means for channeling digital TV signals. DVI also allows for an analog connection, but soon this won't matter; through a federal mandate all TV broadcasts will have to switch over from analog to digital in the near future.

*We should point out that, confusingly enough, horizontal scan lines are not the same thing as horizontal lines of resolution, a measure of picture detail. Horizontal resolution measurements using today's technology can range from 250 for a VCR to as much as 500 for DVD or DIRECTV satellite. Unfortunately, now that you've bothered to learn this, horizontal lines of resolution cannot be used to measure the detail of an HDTV picture. Instead, horizontal scan lines will serve double duty by telling us how many lines of information make up the picture, as well as the potential level of detail.

**Just a couple of caveats: To take advantage of this digital sound, the program material must sound good-"The Honeymooners" will never be anything but low fidelity mono. Second, the speakers in a TV, even a digital TV, will never sound as good as a stereo system, so we recommend introducing your TV to your stereo with a set of RCA cables.

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Flat Panel TV Shopping Guide

Overview

When you look back on history, there is a short list of products that have truly revolutionized our way of life. The printing press, the airplane, and the twist-off bottle cap are some excellent examples. This distinguished list has recently gotten a little longer. Make room for the thin TV. Not too much room though, because these TVs are well... thin!

When it comes to TV, bigger is definitely better. There's nothing like watching sports or a movie on a large screen. There is a problem though. A typical big-screen not only has a large viewing area, it has a large everything. A 55-inch TV can take up as much as 10 square feet of floor space and stand almost 5-feet high.

Thin TVs take care of that problem. You can now have a big TV that takes up considerably less floor space. You can even hang some TVs on the wall and sacrifice zero floor space. Bedrooms, kitchens and even bathrooms are perfect places for thin TVs because they are so small.

These thin TVs aren't just new ways to package old technologies either. They are completely new approaches to television. Gone are the huge glass tubes and projector assemblies we are used to. By taking a different approach to TV, manufacturers are able to make the package smaller without sacrificing picture quality. In some cases, the picture quality of a thin TV is even better than a traditional TV.

There are three basic types of thins TVs to choose from, Plasma, DLP and LCD. Keep in mind that each type has unique characteristics and one may be better suited for your needs than another.

Plasma

Plasma TVs are the "crown jewel" of the thin TV lineup. For most people they are what we always wanted in a TV. A large, stunningly beautiful picture that's under 6 inches thick. Plasma TVs can be hung on the wall, or mounted on a small pedestal. Either way they look more like a piece of art than a TV. Even when they're off.

And because of their revolutionary design, plasma TVs offer some of the best quality pictures available. Plasma TV are made up of tiny gas filled pockets called cells. Pass electricity through a cell and it lights up. Put enough of them together, and the lighted cells make a picture. These cells are so small they are virtually microscopic so an immense number of them can be squeezed onto the screen. This gives you a picture featuring exceptional definition and contrast. The images almost seem to leap off the wall.

DLP (TM)

Digital Light Processing (DLP) TVs are a new spin on an old concept. Projection TVs have been around for quite some time, however their complex system of mirrors and lenses require a considerable amount of space. DLP TVs work in a similar way, but aren't as bulky.

The secret is in the DLP chip itself. A DLP chip is about the same size as an average postage stamp. Packed onto that chip are around one million individual mirrors (Don't worry about having seven million years of bad luck, these chips are very sturdy). Each tiny mirror is capable of moving thousands of times a second. When you shine a light on the DLP chip and move the mirrors, the light they reflect paints a picture on the TV screen.

The advantage of using a DLP chip as opposed to a conventional projector system is two-fold. First, DLP chips allow you much greater control over the picture. The image is more precise corner to corner, as well as being brighter. Second, by using a DLP chip you are able to make the TV much thinner than a regular projection TV. A typical 52-inch DLP TV is only about 18 inches deep, putting DLP TVs well within the thin TV category.

LCD

LCD or Liquid Crystal Display screens have been around for a while. They are most common as screens for laptop computers and some cell phones. LCD TVs are similar looking to plasma TVs, but generally not as big. LCDs do provide an excellent picture in smaller screen sizes at a considerably lower cost though. This makes them ideal for rooms such as the bedroom, or kitchen where space may be at a premium. There are even LCD TVs that come with a built-in DVD player, making them an all-in-one entertainment system.

No matter which style you choose from, you will undoubtedly be happy with your purchase. To make sure you get the best Thin TV for you, consider some of these important features before you buy.

What To Look For

High Definition Upgradeable:

If you see this feature, you know the picture will be spectacular. The "high definition" means that the TV is capable of producing the highest forms (high definition 1080i and high definition 720p) of digital television. The "upgradeable" means that you'll need to add a separate digital receiver in order to receive digital broadcasts. Don't worry. An upgradeable HDTV is a great investment. You'll squeeze every ounce of picture quality possible from a regular DVD player and a progressive scan DVD player will look twice as good. Even when you're watching regular TV broadcasts, the picture will be almost as good as real HDTV because most of these sets have line-doublers to improve the picture.

This feature is sometimes called "HDTV monitor." Incidentally, a DIRECTV HDTV receiver is a great way to upgrade to digital. Not only does it let you receive high definition broadcasts but it can also get you 225 channels, including two that show exclusively high definition programming. You can also get a high definition integrated model, which has the digital tuner built in.

16:9 Aspect Ratio:

The shape of TV is changing. TVs have always had a square-like 4:3 aspect ratio. Widescreen or 16:9 aspect ratio is more of a wide rectangle and it's similar to the shape of a movie screen. Someday all of the TVs available will be 16:9. It makes sense really. Movies are shot with a particular shape in mind. Our culture tends to not only go to the movies, but to also watch movies at home on TV or DVD or VHS.

When you watch a movie at home on a 4:3 TV set you have two formatting options. You can either add the black bars to the top and bottom of the screen or you can cut the edges of the picture off and not show them at all. No matter what option you choose there are drawbacks. Either you are not using the whole TV for the movie, or you are missing part of the movie. With a widescreen TV

this isn't a problem. You get to see the whole movie and use as much of the screen as possible.

Widescreens aren't just for watching DVDs either. Right now, most TV shows are in the old 4:3 format. But HDTV shows are filmed and broadcast in the 16:9 aspect ratio just like movies. Some camcorders even allow you to film in 16:9. The widesreen aspect ratio is definitely the standard of the future.

Reverse 3:2 Pulldown:

Most TV shows are shot on film at 24 frames per second. They're then transferred to video, which runs at 30 frames per second for broadcast. The picture quality loses something in the translation, creating distortions. Reverse 3:2 pulldown corrects those distortions through a series of reconversions. The result is the picture that is a lot smoother and cleaner.

Different TV manufacturers tend to use different terms to describe this feature. So it may take a careful eye to verify that a TV has reverse 3:2 pulldown.

3D Y/C Digital Comb Filter:

The cable you plug into the back of your TV contains all the necessary parts of your favorite shows. But, the sound, the color information and the brightness information are all jumbled together. In order for a TV to use this mess, it has to separate everything out. This is the comb filter's job, and a 3D Y/C comb filter is the best. If your TV does not have a good comb filter, then the edges of objects can become rough and start to move. This effect is called dot crawl. A good comb filter will also lessen the effects of something called moiré. Moiré happens when a finely textured pattern seems to move and ripple when it shouldn't be moving at all. This is easily seen when a television newscaster wears a herringbone jacket.

Picture-in-Picture:

The problem: a great movie on one channel, a great game on the other. The solution: picture-in-picture or P-I-P. Most people are familiar with this feature that allows you to watch a channel while keeping another channel in a box on the screen. You'd pretty much expect to get P-I-P when purchasing a rear projection TV. There are, however, superior P-I-P features to look for.

With a dual tuner P-I-P you don't need an external tuner such as a VCR to change channels. You just plug one cable into the TV and the TV juggles two channels at once. But you can also switch between sources, not just channels. Watch a DVD movie and your stock quotes at the same time. The choice is yours.

There are also TVs that will show the two different channels side-by-side so you don't cover the action from one channel with a small box showing the other. This is called Twin View P-I-P.

Inputs:

There are a few different ways to connect your TV to the various sources out there. When you pick out a TV you should keep in mind what other types of components you have as well as any you are thinking of buying later on.

Component Video inputs are made up of three RCA type plugs and are the highest quality inputs. They actually bypass the comb filter, because the signals are already separated into the parts the TV needs to use. This gives great color separation and detail to your picture. S-Video inputs are small round plugs with four pins inside that work almost as well as component inputs. Regular video inputs (a single RCA plug) are only slightly better than cable TV as far as picture quality.

TVs with a lot of inputs will allow you to connect many different types of equipment to it. You can push one button to switch from the cable to the VCR to

the DVD to the DIRECTV. And the higher quality these connections are, the happier you'll be with the end result.

Quick Thin TV Recap

Thin TVs may be perfect for people without a lot of excess room, but they really are excellent TVs for everyone. The revolutionary technology used to make these TV sets so thin, often leads to a picture far superior to conventional TVs. BesidesÂ...they look really cool.

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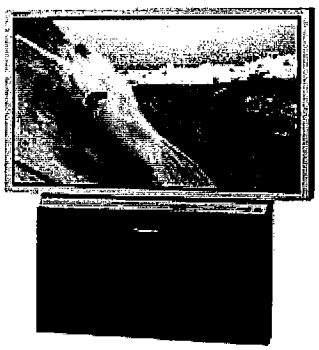
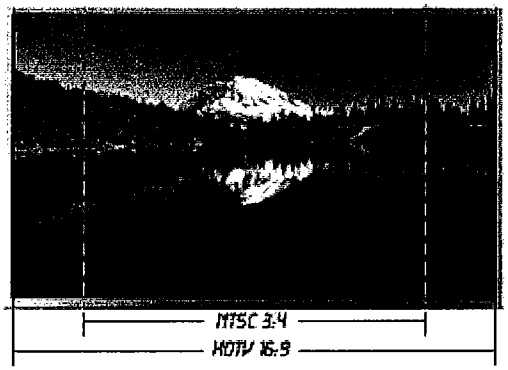
what is hdtv?



HDTV is the new standard that will change television technology as we now know it. HDTV provides an overall viewing experience complete with wide-screen picture quality, CD sound qualit and a variety of other enhancements.

What is HDTV?

HDTV stands for High Definition Television. HDTV provide high resolution programming in a widescreen format. It has twice the picture resolution of today's analog televisions, b vertically and horizontally, which essentially makes the pict twice as sharp. Analog TVs have 480 horizontal lines, whic look fine on a smaller TV, but clarity is lost on larger screen TVs. The HDTV picture can ha up to 1080i active lines adding additional clarity and reduces artifacts (i.e. foggy double images, ghosting). HDTV also has a screen ratio of 16:9 (the picture is 16 units wide to 9 u high) as compared to most current television screens, which have a screen ratio of 4:3.



Aspect Ratio Comparison

Why get HDTV?

Congress has mandated that analog-TV transmissions cease and that digital broadc take over in 2006. The digital transmission of television means that a higher quality picture can be delivered through this new system, and as a bonus you also get digital quality soun High-Definition Televisions display pictures in a higher resolution than analog television, wh significantly increases detail for crisper and cleaner images. The overall viewing experienc enhanced with a picture that comes out sharper, wider, and with incredible digital sound. Additional reasons are: how much data HDTV can transmit, how consistent the data stays distance, and what type of data the signal carries. In the simplest terms, HDTV gives you a better picture, better sound, and digital data.

How do I get HDTV?

HDTV is available from three different digital sources – network/over-the-air broadcasting, digital satellite, or digital cable.

The most common source of network broadcasts from ABC, NBC, CBS, Fox and WB is terrestrial (over-the-air or OTA) broadcasts that you receive through an antenna. Dependin where you live you can use a roof top antenna, or you may even be able to use rabbit ears bow-tie-type antenna, or you could install a larger antenna in your attic. Contact your local broadcaster to determine what programming they currently offer in HDTV.

The second most common source of HDTV signals is via digital satellite transmissions. DirecTV™ and DISH™ Network both offer some HDTV programming such as HBO and Showtime channels in high definition in addition to a limited selection of movies and specia events.

In some regions cable systems carry HDTV broadcasts. Which channels these cable syste carry will vary by region. Remember that a "digital cable system" does not necessarily carr HDTV programming. You should contact your local cable operator to find out if they offer HDTV via their cable system. If they do, you might need a specific HDTV cable receiver wh your cable company will provide for a fee.

What do I need to get HDTV?
There are 2 types of TVs that can display HDTV: high definition TV and high definition read (or high definition capable) TVs.

To receive, decode, and convert HDTV into a signal that your TV can display you'll need a HDTV tuner (also called a "Decoder" or externally, a "Set-Top-Box" or "Receiver"). A true HDTV has this tuner built in. A HD ready TV allows connection of an outboard HD tuner (S Top-Box) and is capable of displaying a HD (1080 line) signal. Whether it's built into the TV not, the result is the same. The tuner receives the HD signal and converts it to an analog si that can be output to the HD ready TV, usually though a component video connection. But whether it's a HDTV or HD ready TV with an outboard tuner you will only be able to access over-the-air signals.

If you receive your signal via cable the cable box acts as the decoder and outputs a signal the TV, but only for the cable signal. You won't be able to receive over-the-air HD broadcas

Digital Satellite receivers that are HD capable also decode HD satellite broadcasts, but ma digital satellite receivers also decode over-the-air HD broadcasts as well, allowing you to receive local and satellite programming with only one box.

Bottom Line -
What equipment do I need ?
There are three things required to view HDTV:

1. A Digital Source – (over-the-air broadcasting, digital satellite, or digital cable)
2. HDTV Tuner (Set-Top Box) or Cable Box with built-in HDTV Decoder
3. Digital TV (HDTV & HDTV Ready)

1. Digital Sources

- Free Broadcasts: Free Over-The-Air (OTA) HDTV broadcasts are already available most viewers in the US. In most areas, all you need is an outside antenna or a small indoor antenna.
- Digital Satellite Service: For a monthly fee you can receive DTV with a satellite dish tuner. Digital satellite services provide hundreds of channels of digital picture, Dolby Digital sound, and interactive features. Most DTV satellite programming is SDTV, bu some channels and events are HDTV.

- Digital Cable TV Service: Available in many areas and expanding across the US. If y currently have cable service, your provider may carry SDTV and HDTV signals alrea You will just need to add a proprietary digital tuner (set-top box) for decoding.

2. HDTV Tuner (Set-Top Box)

A HDTV tuner receives and decodes different types of broadcasts from different providers. This is more cost-effective than equipping digital TVs with several tuners and decoders, an allows you to choose only the signals you want. There are three types:

- HDTV Tuner: for free over-the-air HDTV and DTV signals (requires an antenna)
- Cable Tuner: for digital cable signals (may require an additional tuner for over-the-ai broadcasts and an antenna)
- All-In-One Tuner: for both over-the-air and satellite signals (requires an antenna and satellite dish)

Check out goodguys.com's selection of HDTV Tuners (Set-Top Boxes) >>

3. Digital TV Monitors

Digital monitors are the best choice when it's time to buy a new TV. goodguys.com offers several digital TVs types with multiple features to fit your tastes and your budget:

- Direct View HDTVs
- Projection HDTVs
- Plasma TVs
- LCD TVs

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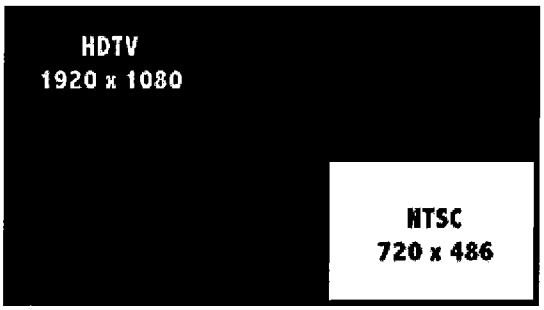
1. What is the difference between DTV, SDTV, & HDTV?

- **DTV** – Digital Television is an umbrella term that describes any digital TV signal (standard definition SDTV and high definition HDTV). Digital TV signals transmit cod instructions (ones and zeros) to a HDTV Tuner (also called a "Decoder", or externall "Set-Top-Box" or "Receiver"). The tuner deciphers the digital code and reproduces a superior picture, whereas analog transmits only a video signal. During the transmiss of an analog signal, a weaker signal or interferences can cause the picture to be distorted or snowy.
- **SDTV** - Standard Definition Television or SDTV refers to a digital signal that is transmitted with a 480-line resolution. The signal can be in either an interlaced or a progressive scanned formats. Overall, SDTV offers significant improvement over toc current picture resolution, similar to comparing DVD quality to VHS, primarily becaus the digital signal eliminates snow and ghosts, common with the current analog forma However, SDTV does not come close to HDTV in both visual and audio quality.
- **HDTV** – High Definition Television or HDTV basically has more pixels and a greater resolution. HDTV can have a resolution of up to 1920 x 1080 (current TVs have 720 486). That's 2,073,600 pixels, or six times more pixels than the resolution of current television pictures. So when you look at comparable sizes of HDTV and current TVs HDTV will have smaller, square pixels and more of them. Images will be crisper and cleaner.



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2. What is 'HDTV-Capable' or 'HDTV-Ready'?
Generally more affordable, these TV sets can display both NTSC 'analog' signals and ATS 'digital' signals, BUT these sets do require an external, HDTV Tuner to receive and display HDTV programs. Be sure you verify that the HDTV Tuner is compatible with the following:

- HDTV set you are purchasing,
- The 'direct broadcast service' (DBS) (Satellite/Cable) you expect to use
- Also capable of receiving Over-The-Air (OTA) broadcasts

In addition, it is highly recommended that the HDTV set has DVI inputs. DVI inputs provide secure digital interface for connecting the HDTV tuner to an HDTV-Capable television. This connection delivers digital data directly and eliminates the process of converting digital to analog. This allows transfer of the clearest image with the least amount of artifacts.

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3. What HDTV Tuner will work?
Verify that the Tuner you're buying is compatible with the HDTV Set you will be buying, as as the DTS ("Direct TV Service" - Satellite/Cable) you subscribe to, and that it is capable of receiving OTA (over-the-air) Broadcasts. Some tuners are exclusive to the Digital Satellite Services, while others are "All-In-One" and able to decode signals from different sources. Cable subscribers will need to check with their Cable Company for information regarding compatibility with their cable tuner.

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4. When will TV stations start to broadcast digital signals?
As of November 1999, digital broadcasts will have reached the top thirty markets, accounting for roughly 50% of the U.S. population. By 2003, digital broadcasts will be available in every market in the country.

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5. Will TV stations stop broadcasting regular signals immediately when they switch to digital?
No. Stations are required to broadcast regular TV signals alongside the digital programming until at least 2006 and probably well beyond.

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6. Should I wait before I buy a new TV?
Not necessarily. If you're in the market for a new TV, but not yet ready to buy a new digital you should know that a good quality conventional TV will be able to show DTV broadcasts when used with a HDTV Tuner.

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7. What will a digital picture look like on my conventional TV?
A DTV picture viewed on your conventional TV with the use of a HDTV Tuner will be comparable to a picture from a digital broadcast satellite (DBS) or DVD player. This is an improvement over conventional broadcast television, because DTV signals can't be degrad by environmental interference that would otherwise cause "snow" or "ghosting".

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8. Will I need an antenna?
Yes. Initially, DTV will only be available over the air. This means you will need an antenna t receive it. Outdoor or attic antennas will be generally more effective than set-top versions. I the future, DTV network programming may become available from cable and satellite providers.

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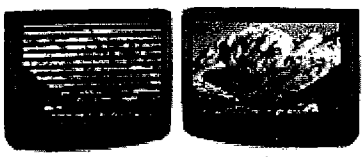
9. What's the difference between interlaced & progressive scanning?
These designations refer to the method by which the lines of picture information will be scanned in 1/30th of a second to create the image on your screen. "Interlaced" means alternate lines scanned in alternate passes, the way conventional TV sets currently work, w "progressive" represents sequential scanning of all lines in a single pass, the way compute monitors display their information.



Interlaced vs Progressive Scan

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10. Will all digital programs be transmitted in the 16:9 wide-screen format?
No. All HDTV and some SDTV programs will be transmitted in the 16:9 wide-screen aspect ratio (the format of movie theaters). Aspect ratio refers to the width of a picture relative to it height.

The Aspect Ratio — can be 4:3 or 16:9 with the new SDTV formats.

	
Today's conventional TV aspect ratio is 4:3.	DTV broadcasts may also be delivered in the 16:9 format, the same as many movie theater screens.

Today's conventional TV aspect ratio is 4:3. SDTV programming may utilize 16:9 or 4:3. Of course, wide-screen programs can be viewed on conventional TV screens in the letterbox format (black areas above and below picture). Likewise, you'll be able to view regular aspe ratio pictures on a wide aspect TV screen, with the picture digitally "stretched" to fill the scr or with gray areas on both sides of the picture.

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11. Will I be able to view digital broadcasts on my cable system?

There is currently no FCC schedule for cable or satellite providers to deliver DTV programming. However, since 65% of U.S. households currently subscribe to cable and mc than 10% have satellite programming, providers will likely start passing along DTV broadca in the future. In either case, a HDTV Tuner would allow you to view DTV programming on y current TV, giving you the best picture your current set could provide.

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12. What About My VCR, DVD Player And Camcorder? Will I Be Able To Use Them With An HDTV Set?

HDTV sets are "backward compatible," meaning all existing analog equipment (VCRs, DVI players, camcorders, video games, etc.) will work on digital TV sets, but not necessarily in l definition. Video will be displayed in the maximum resolution of which each product is capa

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13. Is The Sound Different?

Complimenting the lifelike pictures are 5.1 channels of CD-quality digital audio. Current ste TV sets offer only two channels of audio. HDTV can deliver true surround sound: front speakers on the right, center and left, along with two back speakers and a subwoofer.

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goodguys.com hdtv glossary of terms

0-9- A- B- C- D- E- F- G- H- I- J- K- L- M- N- O- P- Q- R- S- T- U- V- W- X- Y

16:9
The width-to-height ratio of widescreen TVs and HDTVs. This screen ratio is presently consic the most likely contender to be adopted by the ATV committee for future widescreen broadca

- **Benefit:** Allows you to watch movies in the original wide-frame format and not miss any imagery

3/2 Pulldown
See **Progressive Cinema Scan** below for definition.

4:3
The width-to-height ratio of standard televisions.

AC-3
See **Dolby® Digital** below for definition.

Advanced Television Systems Committee (ATSC)
Also known as ATSC, the committee responsible for digital television standards and development, as well as all 18 formats of DTV.

ATSC Tuner
A component, or part of a component, that receives the enormous bandwidth that is necessai read the HD signals set at ATSC standards.

A/D
Analog to digital conversion (or converter). Used at transmission end of broadcast.

Analog TV
"Standard" televisionbroadcasts analog TV. Analog signals vary continuously, representing fluctuations in color and brightness. The screen resolution of an analog TV is about 512 x 40(pixels.

Anamorphic
The process of compressing wide screen images, 1.78:1 or greater, to fit into the bandwidth c standard 1.33:1 television signal. The images are then expanded for viewing in their original format on a widescreen display device.

Artifacts
Unwanted visible effects in the picture created by disturbances in the transmission or image processing, such as edge crawl or hanging dots in analog pictures, or pixelation in digital pict

Aspect Ratio
Refers to the width of a picture relative to its height. If an NTSC picture is four feet wide, it wil

three feet high; thus it has a 4:3 aspect ratio. HDTV has a 16:9 aspect ratio. (The relationship width to height in a television set. Traditional Color Television product features a 4:3 aspect r Widescreen and future HDTV products will incorporate a 16:9 aspect ratio.)

A/V (Monitor) Inputs Permits direct connection of your VCR, DVD or Home Satellite Receive your television set for playback purposes. When compared to RF performance (channel 3/4), direct video inputs can improve picture performance by as much as 20 percent.

A/V Outputs
These outputs allow you to easily send the audio/video signal to a VCR or DVD recorder for recording. Fixed audio outputs can also be connected to an A/V receiver to provide a cleaner signal for two-channel based home theater systems.

- **Benefit:** Simple connection of A/V signals to additional components for recording or amplificatio

BBE® High-Definition Sound
Improves speech intelligibility, and restores the dynamic range of musical passages to help provide a m natural sound.

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Bit Rate
Measured as "bits per second," and used to express the rate at which data is transmitted or processed. higher the bit rate, the more data that is processed and, typically, the higher the picture resolution.

CCD Comb Filter
Charged Coupled Device separates Luminance and Chrominance elements of a color video signal. Mo efficient than glass CCD.

Closed Captioning
Dialog is displayed on screen in a manner similar to subtitles in movies.

- **Benefit:** Originally designed for use by hearing-impaired individuals, captioned displays may als utilized to improve reading skills and assist in the learning of English as a second language.

Component Video Connection
The output of a video device (such as a DTV set-top box), or the input of a DTV receiver or monitor consisting of three primary color signals: red, green, and blue that together convey all necessary picture information. With current consumer video products, the six component signals have been translated int luminance (Y) and two color difference signals (PP, PR), each on a separate wire.

Composite Video Connection
An analog, encoded video signal (such as NTSC) that includes vertical and horizontal synchronizing information. Since both luminance (brightness) and chrominance (color) signals are encoded together, single connection wire is needed (i.e. RCA cables).

CRT
Acronym for a Cathode Ray Tube, consisting of a phosphor panel, and electron gun.

D/A
Conversion of digital to analog signals. The device is also referred to as DAC (D/A converter). In order f conventional television technology to display digitally transmitted TV data, the data must be decoded fir and then converted back to an analog signal.

Digital Television (DTV)
Refers to all formats of digital television, including high definition television (HDTV), and standard defini television (SDTV), which is also referred to as ATV (advanced TV). DTV is the transmission, reception a display of pure digital signals on a digital TV set. The digital signals can be broadcast over the air for fre transmitted by a cable or satellite system to your home with a subscription. Stations choose which form

broadcast. In your home, the decoder (located inside the TV or in a set-top box) receives the signal and directly drives your digital TV set.

Digital TV Formats

- Six HDTV formats: Five progressive scanning (720p - 1280x720 pixels progressive) and one interlaced scanning (1080i - 1920x1080 pixels interlaced).
- Eight SDTV formats: four wide-screen formats with 16:9 aspect ratios
- Four video graphics array (VGA) formats

Digital Velocity Modulated Scan (Selectable)
Advanced circuitry along the neck of the CRT senses transitions from black to white in the video signal. black and white portions of the signal are sped up and slowed down, respectively, resulting in sharp bla white transitions. For a more film-like picture when watching movies, you may want to selectively turn of circuitry.

Dolby™
A compression/expansion (companding) noise reduction system developed by Ray Dolby, widely used consumer, professional and broadcast audio applications. Signal-to-noise ratio improvement is accomplished by processing a signal before recording and reverse-processing the signal upon playbacl (www.panasonic.com)

Dolby Digital (AC-3)
Delivers CD-quality digital audio and provides five full-bandwidth channels for front left, front right, cente surround left and surround right speakers, plus an LFE (low frequency effect) subwoofer, for a total of 5 channels.

Dolby Digital Surround
Perceptual encoding data reduction system that provides 5 discreet full range (20-20khz) channels (L-C LS-RS) and a dedicated low frequency effects channel replicates the Theater experience in the home. (Dolby Digital 5.1 (AC-3) channel surround sound is the audio standard for HDTV. This provides audio channels for the front speakers (left, center, right); 2 channels for the rear surround sound and one chai for the subwoofer sound. You need a TV or an external audio system which is capable of AC-3 to get th effect.

Dolby Pro Logic
Four channel audio system including Left, Right, Center and Surround. Utilizes active signal decoding t localize the position audio images within the sound stage. Differentiated from Dolby Surround by the ad of center channel information and active signal processing.

Dolby Surround Sound
Left and Right Rear Channel information is decoded and processed following specific delay and frequer response parameters to provide a dramatic environment of sound that envelopes you from all directions

Downconvert
A term used to describe the format conversion from a higher resolution input signal number to a lower display number, such as 1080i input to 480i display. (www.panasonic.com)

DTS (Digital Theater Systems, Inc.)
DTS is a worldwide brand name that is synonymous with high quality digital sound. Digital Theater Syst Inc. develops, markets and licenses a range of proprietary digital audio technologies, products and cont for the motion picture and consumer markets. DTS developed discrete 5.1 channel surround systems si to but not the same as Dolby Digital. (www.dtstech.com).

DTS-ES Discrete 6.1
A true 6.1-channel format, as the back surround audio channel is discretely encoded into the DTS bitstr This format offers better spatialization over the surround channels for complete 360-degree sound localization and surround pans (i.e., movement of sound in the surround channels from one side to anot A data flag signals the decoder (usually part of the receiver or pre-amplifier) that the bitstream contains extra discrete back surround channel. For backwards compatibility, DTS-ES Discrete 6.1 back surrounc channel is ignored by DTS 5.1 equipment. (www.timefordvd.com)

DVI Upgradeable (Digital Visual Interface)
DVI is an uncompressed (base band) digital video connection. It provides a secure digital interface for connecting a Digital Set-Top Box to an HD Compatible TV. It is not made to replace IEEE1394, which c still be used to connect the Digital **EDTV (Enhanced Definition Television)**
EDTVs are between High Definition TV (HDTV) and Standard Definition TV (SDTV). EDTV products are digital TVs with higher display performance than SDTV. EDTV has a resolution of 480p. The "p" stands "progressive," since all 480 lines are scanned (drawn) one after the other, rather than odd and even numbers separately. EDTV draws all 480 horizontal lines one after the other, rather than all the odd one followed by all the even ones. The effect for the viewer is dramatic. The scanning lines aren't nearly as visible as they are with SDTV. (digitalaudioguide.com)

EPG
Electronic program guide. An on-screen display of channels and program data.

FCC (Federal Communications Commission)
All stations be capable of broadcasting HDTV by 2006 according to the FCC.

HD Ready-TV (High Definition-Ready Televisions)
Requires the addition of an external tuner/decoder (set-top box) to receive digital broadcasts. In an HD-Ready set, you buy the HD tuner separately.

- **Benefit:** This approach keeps your initial cost down and lets you upgrade to HDTV when there i more plentiful supply of programming. Your HD Ready set will still offer a dramatically improved picture and allow you to enjoy a superior digital picture when using a DVD.

HDTV (High Definition Television)
High-resolution digital television (DTV) combined with Dolby Digital Surround sound (AC-3). The resolut up to 1080i scanning lines (interlaced) or 720 p. Dolby Digital 5.1 channel surround sound is the audio standard (AC-3). HDTV sets come in two forms:

- HDTV sets: receiver/decoder is built in.
  Benefit: A higher screen resolution means a crisper, clearer picture. This combination creates a stunning image with stunning sound.

- HD-Ready sets: require the addition of an external receiver/decoder (set-top box) to receive digi broadcasts. In an HD-Ready set, you buy the HD receiver separately.
  Benefit: This approach keeps your initial cost down and lets you upgrade to HDTV when there i more plentiful supply of programming. Your HD Ready set will still offer a dramatically improved picture and allow you to enjoy a superior digital picture when using a DVD.

Interlaced Scanning
In a television display, interlaced scanning refers to the process of re-assembling a picture from a series electrical (video) signals. The "standard" NTSC system uses 525 scanning lines to create a picture (frar The frame/picture is made up of two fields: The first field has 262.5 odd lines (1,3,5...) and the second fi has 262.5 even lines (2,4,6...). The odd lines are scanned (or painted on the screen) in 1/60th of a seco and the even lines follow in the next 1/60th of a second. This presents an entire frame/picture of 525 lin 1/30th of a second.

Invar Shadow Mask
Most picture tubes use standard shadow masks made of steel, which can expand under intense heat. Expansion of the shadow mask causes picture discoloration, often called "doming." But Invar shadow m are made of a compound of iron and nickel, rendering them extremely heat-resistant.

- **Benefit:** This high thermal tolerance eliminates doming and allows the tube to operate at a high voltage, producing brighter whites, higher contrast, and purer colors.

Line Doubling
A method, through special circuitry, to modify an NTSC interlaced picture to create an effect similar to a progressively scanned picture. The first field of 262.5 odd-numbered lines is stored in digital memory ar combined with the even-numbered lines. Then all 525 lines are scanned in 1/30th of a second. The resu improved detail enhancement from an NTSC source.

MPEG (Motion/JPEG)
Refers to the Motion Picture Expert Group which developed the MPEG series of audio and video compression standards. It is a digital compression standard for moving video images that allows the ima to occupy less memory or disk space. Like the JPEG standard, it includes options for trading off betwee storage space and image quality.

MPEG-2
A system adopted by the Motion Picture Experts Group (MPEG) for compressing digitized video to save bandwidth. Coded for DVD, HDTV broadcast, cable TV, digital satellite systems (5-20MB per second).

MP3
MP3s are digital music files made from contents recorded on CD-R/RW media from CDs for your perso use. Playability may vary depending on contents and discs. MP3s are popular due to their compression audio quality and versatility, and can be played in most digital music players and PCs. (Panasonic)

MTS Stereo/SAP with DBX®
An MTS (Multi-channel Television Sound) decoder enables the television to accept and decode a broac stereo signal. Unlike some systems that delete DBX® , MTS provides the full quality of the original stere broadcast. SAP (Secondary Audio Program) enables the reception of bilingual broadcasts, when availa

- **Benefit:** Full broadcast stereo sound quality, plus access to bilingual or secondary audio signals

Multilingual On-Screen Display
TV functions can be easily operated and personalized using the remote control to access the on-screen display menu. Most manufacturers offer multilingual display options.

NTSC
Acronym for North American Television Standards Committee. This is the group responsible for develop and maintaining standards for current broadcast system in North America.

PAL (Phase Alternate Line)
The European color TV broadcasting standard featuring 625 lines per frame and 25 frames per second. NTSC and SECAM)

PIP (Picture In Picture)
Lets viewer watch two shows at once when using a second signal input source, such as a VCR.

Pixel
Short term for picture element, a single displayable video dot.

Progressive Cinema Scan (3/2 Pulldown)
Provides more faithful reproduction of film-based materials. Movies on film are converted to NTSC interl video (480i) for television by a process known as telecine conversion, in which the 24 frame-per-second is converted to video at 60 fields per second. The fields are then paired to create 30-frame-per-second video. Some of the frames will contain dissimilar pairs of fields derived from two different frames of the original film, which causes artifacts. Generally, when 480i video is converted to progressive scan (480p) artifacts from the telecine process will remain. Progressive cinema scan circuitry, by contrast, converts video to 480p while restoring the original frames of the film for a more faithful movie reproduction.

Progressive Scanning
In progressive scanning, typically used by VGA computer monitors, all 525 odd and even scanning lines "painted" by the Electron Beam every 1/60th of a second which reduces flicker and increases vertical resolution. Adopted DTV formats include both interlaced and progressive broadcast and display methoc

- **Benefit:** Provides a much smoother picture, but uses slightly more bandwidth.

Resolution
The density of lines and dots per line which make up a visual image. Usually, the higher the numbers, th sharper and more detailed the picture will be. In terms of DTV, maximum resolution refers to the numbe horizontal scanning lines multiplied by the total number of pixels per line, called pixel density.

RF Video Connection
"RF" stands for radio frequency, and it's the simplest kind of cable for linking an audio-video source to a television. The cable service that comes into your house is an RF path; it combines sound and picture f easy hookup to your television or VCR. RF is the poorest method of getting sound and image from one component to another.

SAP
Secondary Audio Program. Third channel provided in MTS signal (L-R-SAP). Used for bilingual broadca and for informational purposes (National Weather Service broadcasts, etc.)

SDTV
Digitally transmitted SDTV includes 480 line resolution in both interlaced and progressively scanned for It offers significant improvement over today's conventional NTSC picture resolution, and is similar to DV DBS quality because the digital transmission eliminates snow and ghosts, which can be common with tl current NTSC TV format. Also, thanks to digital compression technology, several programs can be transmitted simultaneously within the same channel.

SECAM (Sequential Couleur A'memorie, Sequential Color With Memory)
Video standard used in European and surrounding countries. In countries using the SECAM standard, r video production is done using PAL and converted to SECAM prior to transmission. (See NTSC and PA

Set-top Box (DTV STB)
A unit similar to today's cable boxes, which is capable of receiving and decoding DTV broadcasts. A DT "Certified" STB can receive all 18 ATSC DTV formats and provide a displayable picture.

Simulcast
The simultaneous broadcasting of the same program on two different channels or frequencies. The FC(requires that over the next few years much of the networks' DTV content be simulcast with regular TV.

Spectrum
A range of frequencies available for over-the-air transmission.

Surround Sound Allows the consumer to enjoy an enhanced home theater experience without connec of external speakers. Many televisions incorporate some type of surround processing.

- **Benefit:** Makes the viewer feel more like they are part of the on-screen action.

S-Video (Separated Video)
An encoded video signal which separates the brightness from color data. S-video can greatly improve tl picture when connecting TVs to any high quality video source such as digital broadcast satellite (DBS) a DVDs. (S- Video Inputs : Use of Separated (S) Video input for playback of Laserdisc players, high performance VCR and Home Satellite Receivers reduces dot crowl in the picture, providing sharper edg detail.)

THX®
THX Certified offers an entire cinema environment that is designed and tested to ensure that it meets al standards for sound and picture excellence. It was established with the goal of ensuring that cinema auditorium sound was reproduced exactly as it was intended by the filmmaker. (THX.com)

Two Tuner PIP
Separate tuners, one for the main picture and a second for the PIP inset allow you to watch two broadc T.V. programs simultaneously without having to turn on a VCR to provide an additional tuner source.

Universal Remote Control
Universal remotes are capable of operating various components (TV, DVD player, VCR, Cable Box, Receiver, etc) by programming specific manufacturer codes for each component. Amount of operable components varies by remote.

Upconvert
The term used to describe the conversion of a lower apparent resolution to a higher number, such as "upconverting" 720p to 1080i. This is a misnomer, though, since to accomplish this, the horizontal scan frequency is actually lowered from 45kHz to 33.75kHz. Resolution quality is not improved by this metho

V-Chip Parental Control System
Allows adults to decide which show ratings are appropriate for their children. The television will then blo out the video and audio of any program that has a rating beyond the selected level. Adults can override system at any time using their secret code.

- **Benefit:** Parents can easily limit the types of the programs their children are watching.

Y, PB, PR
Generally used where a digital TV signal source is employed. The video signal is separated into its component parts of brightness and color differentials. The most advanced method for interconnecting decoded video data.

Y, U, V
Also sometimes referred to as Y, Cr, Cb, where a video signal is separated into components of brightne and color, arguably to a degree more advanced than S-video.

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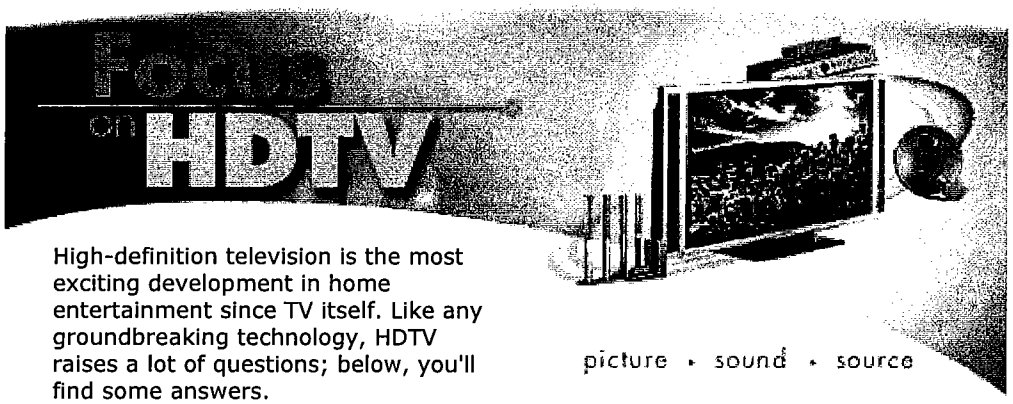
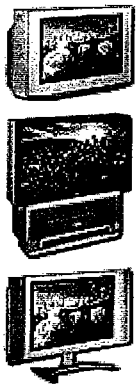


High-definition television is the most exciting development in home entertainment since TV itself. Like any groundbreaking technology, HDTV raises a lot of questions; below, you'll find some answers.



Picture

Why upgrade your TV?

Here's the skinny on HDTV's clear advantages.

Which display technology is right for you?

There are a lot of variables to consider, and sometimes the decision can seem overwhelming. This basic overview of the dominant HDTV display technologies should help:

- Direct-View (CRT or Tube TVs)
- Projection
- LCD
- Plasma
- DLP
- LCOS

Source

Which HDTV set-top box?

The number of programs broadcast daily in high-definition is constantly increasing — from hit prime-time series, to sporting events, to movies, nature programs and more. But in order to enjoy the full potential of your high-definition TV, you'll need an HD source. Currently, there are three primary systems that will deliver HD programming to your home:

- Over-the-Air (OTA)
- Satellite
- Digital Cable

Making a new connection

Many HDTV set-top boxes come equipped with one or more unfamiliar-looking ports and sockets, but don't be intimidated. Making the connection is easy, if you know what you're looking at.

Sound

What's so great about surround sound?

A spectacular picture is only part of the HDTV difference; multichannel audio makes the experience real.

Surround formats

How Dolby Digital 5.1 and Dolby Pro Logic II enhance the HDTV experience — and what you'll need to enjoy them.

For a more comprehensive discussion of surround sound for movies, music and beyond, visit our Surround Sound Info Center.

Accessories
Through the connectivity jungle
Along with new high-bandwidth digital interfaces (see **Making a new connection**, above), state-of-the-art HDTVs typically sport a daunting variety of standard A/V connections. Believe it or not, they can be your friends — provided you know what they're for. Our Cable Guide untangles the mystery.

The joy of control
A full-blown HDTV home theater system includes multiple components, each with its own set of functions and controls. A carefully chosen universal remote can minimize clutter and confusion to bring you more enjoyment from your investment.

Professional Installation
Get it right the first time
With expert installation and setup by our highly trained technicians, you can skip the hassle and get right to the fun. After all, that's what this is all about.

COMPANY INFORMATION	STORE SERVICES	SHOPPING SERVICES	PRODUCT SERVICES	INSTALLATION SERVICES
About Us	Store Pickup	Financing Offers	Rebates	Car
Careers	Returns & Exchanges	Gift Cards	Warranties	Home Entertainment
For Our Investors	Store Locator	Best Buy Credit Card	Service Plans	Satellite
Business to Business	Weekly Ad	Affiliates Program	PC Upgrades	Appliances
Community Relations		Offer Sign-Up	Repairs	
			Replacement Parts	

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CLOSE

What are DTV and HDTV?
Since High-Definition Television (HDTV) designates the highest-quality display formats defined in the Digital Television (DTV) standard, it's important to first understand the implications of digital TV broadcasting.

DTV is a new, more advanced way of delivering televisions signals to your home — whether over the airwaves or via satellite or cable-based systems. It's intended to eventually replace analog TV broadcasting altogether; in fact, according to the current schedule, all TV stations in the United States are mandated to begin providing digital programming to their viewers no later than 2006. Thus, the changeover to digital TVs and digital source components is inevitable, and in fact is already well under way. We'll all be enjoying the benefits of this new technology very soon, and a new TV will be part of the equation.

What's meant by "HD-Ready"?
Some HDTV sets on the market incorporate HD-capable displays coupled with a built-in HDTV tuner to receive over-the-air HD broadcasts (currently available only in certain markets, these broadcasts are becoming increasingly common as the 2006 digital-broadcast deadline approaches). Often referred to as *integrated HDTVs*, these models are indicated on the BestBuy.com Web site by the designation "with Built-In HDTV Tuner."

However, the vast majority of HD-capable TVs on the market are what's known as *HD-ready TVs* (or *HDTV monitors*) — high-definition displays, often including one or more built-in NTSC TV tuners for reception of conventional analog TV broadcasts, but which must be connected to a separate HD source in order to realize their full potential. Since most current HD content is delivered via satellite or cable systems rather that over-the-air, some consumers (especially those who reside in areas where over-the-air HD content is not yet available) consider an HD-ready set to be the best solution for their current and future needs. But to experience HD broadcasts (where available) right out of the box with no additional investment, a built-in HD tuner is the ticket.

Like HD-ready models, integrated HDTVs generally provide exhaustive connectivity options, so you can always add cable or satellite sources as well to broaden your HD options. Conversely, over-the-air HD tuners are also available in stand-alone set-top boxes, often combined with cable and/or satellite reception capabilities. Obviously, there are lots of ways to achieve your desired HD viewing experience, so we advise you to weigh various factors (including cost, convenience, and content availability) before making your decision.

Why HDTV?
Superior resolution
HDTV offers a number of compelling advantages over its analog forbears. If you've visited a Best Buy store recently, you already know about the most obvious: The picture is breathtaking. The primary reason is enhanced resolution.

A TV picture is made up of lots of tiny horizontal rows (called scan lines) of individual pixels, or picture elements. The more rows — and the more picture elements — a screen can reproduce, the clearer and sharper the picture.

Your old analog TV's picture is made up of 480 visible horizontal lines, each comprising a maximum of 720 pixels. By contrast, HDTVs can reproduce up to 1080 horizontal lines of 1920 pixels — resulting in a picture that's a jaw-dropping 6 times as dense. HDTV also has the advantage of enabling progressive-scan display (useful with the latest DVD players as well as TV broadcasts). To understand the picture benefits of progressive scanning, see our primer on the topic.

Widescreen aspect ratio
You've probably also noticed that many HDTV screens are wider, relative to their height, than the TVs you're accustomed to. To be specific, most newer HDTV models feature what's known as a 16:9 (widescreen) aspect ratio (the ratio refers to the relationship between horizontal and vertical dimensions), as compared to the 4:3 aspect ratio of older TVs. HDTV programming, by definition, is delivered in this wider aspect, which is better suited to the reproduction of most movies, not to mention providing a broader, more revealing perspective on sporting events and other programs.

Regardless of their screen dimensions, all HDTVs and HDTV monitors can reproduce high-definition programming in its intended 16:9 aspect. 4:3 sets typically handle the conversion by compressing the horizontal scan lines to fit within the vertical picture area, leaving black or gray bars above and below the image (letterboxing).

Dolby Digital 5.1 audio
Another huge advantage of HDTV is less obvious at a glance: the capability to broadcast programs in Dolby Digital 5.1-channel surround sound. If you're already enjoying DVD movies in surround (with the help of a 5.1-channel audio system), you're already familiar with the realism and excitement it brings to the experience. Imagine feeling just as immersed in practically every TV program you watch! HDTV can take you there, provided you're properly equipped.

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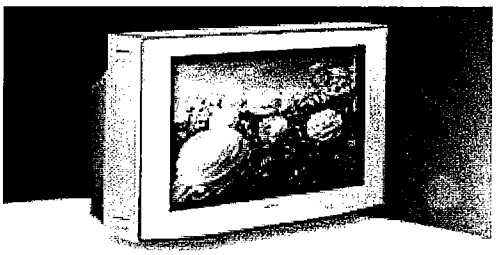
Direct-View (CRT or Tube TVs)



Of all the technologies capable of high-definition display, direct-view HDTVs and monitors most closely resemble the familiar analog TVs of old. They're built on the same fundamental design principles as your analog set, but with improved technology for enhanced performance. Unfortunately, like analog tube TVs, they are inherently bulky and heavy, creating serious impracticalities relating to the manufacture, shipping and storage of large-screen models. As a result, the largest screen size currently available in direct-view HDTVs is 40".

Strengths

CRT (cathode-ray tube) technology excels in a number of important areas. First, it is capable of reproducing deeper, darker blacks than any other display technology, rendering images of excellent contrast and realism. It is bright enough to be viewed in a fully-lit room, and the picture's superb color characteristics remain intact regardless of viewing angle. And since there's only one light source (the CRT itself), direct-view TVs don't require periodic convergence adjustments to retain their chromatic integrity, the way some projection TVs do.

Considerations

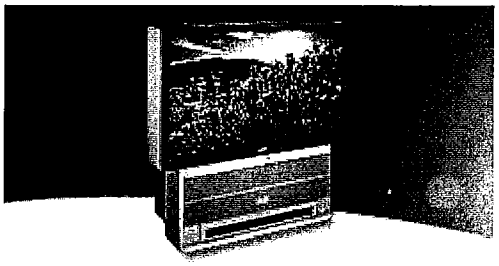
Their aforementioned bulk and weight make larger direct-view sets difficult to accommodate in crowded rooms, and a real challenge to move. Their traditionally curved screen surfaces reflect glare from ambient light in the viewing area, but the emergence of perfectly flat picture tubes (virtually every late-model HDTV set has one) has significantly improved their performance in this area.

The bottom line

Direct-view HDTVs offer excellent performance at a relatively low cost. If you can afford the space, and don't require an exceptionally large screen, a direct-view model may be a good choice.

CLOSE

Projection TVs



Projection TVs come in two basic flavors: rear-projection and front-projection. Technically, some rear-projection TVs, and virtually all front projectors, employ one of the other display technologies (DLP, LCD or LCOS) examined in more detail elsewhere in this guide. In this section, we'll focus on CRT rear-projection TVs.

Strengths

Rear-projection sets use three separate cathode ray tubes (CRTs) — one each for the red, green and blue elements of the picture. The beams from the three tubes are then combined, magnified and projected onto a specially formulated screen that diffuses and transmits the light as a single composite image. Screen sizes range from about 42" up to 65" and beyond, contained in a large cabinet that encompasses the light sources, electronics and projection system.

Rear-projection technology is the least advanced of current projection technologies, but still is capable of providing true high-definition performance and a big screen, for a fraction of the cost of newer technologies.

Considerations

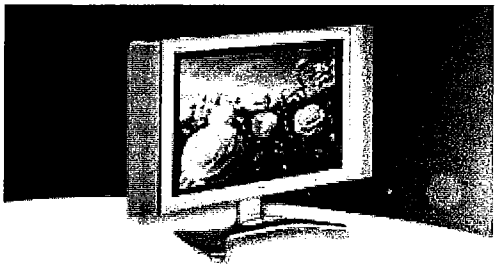
To efficiently focus a limited amount of light onto a broad surface area, the output of a rear-projection TV is limited to a relatively narrow viewing area compared to other big-screen options; the picture tends to fade and discolor as one moves away from the central axis of the screen. It is generally necessary to darken a sunlit room to view a rear-projection TV. Because there are three separate light sources, periodic adjustment is necessary to "converge" the CRTs into a single, crisp image (late-model projection TVs have automatic digital convergence features to simplify the process). Extended viewing of static image elements (such as video-game gauges, stock-ticker streams and even letterbox/windowbox bars on content that doesn't match the screen dimensions) can leave a permanent imprint on the screen over time, called "burn-in" — though recent models incorporate advanced features designed to minimize this effect.

The bottom line

Like direct-view sets, CRT rear-projection HDTVs offer a potent combination of performance and features for relatively little money. Their bulk makes them inconvenient for some people, who may prefer to consider a sleeker flat-panel design (LCD or Plasma) or a shallower projection variety like DLP or LCOS.

CLOSE

LCD



Along with plasma, LCD (liquid crystal display) technology represents a revolution in television design: the truly flat TV. LCD flat-panel displays typically measure around 3" in depth, and are lightweight enough to be mounted on a wall (although they also look mighty sleek on the artsy stands designed to display them on tabletops). LCD is a transmissive technology (as opposed to reflective technologies like DLP and LCOS). Its light engine streams high-intensity white light (provided by a series of flourescent tubes woven behind the screen surface) through tiny cells filled with a liquid crystal material. Each pixel has three such cells — one each for red, green and blue components of the signal. When an electrical charge is applied to the liquid crystals, their molecular structure shifts, modulating the intensity of the light that passes through to the screen. LCD TVs are available many sizes, from 10" standard-definition models to widescreen HDTV showpieces of 37" or more.

Strengths

LCD technology produces an exceptionally bright picture that can easily be viewed even in very bright conditions. The images are characterized by outstanding sharpness and detail and rich, saturated colors. LCD TVs use relatively little electricity, run cooler and more quietly than most plasma displays, and are essentially immune to the "burn-in" problems that plague CRT-projection and plasma TVs. Slim, sleek and lightweight, they can be placed or mounted almost anywhere in the home, including places where you might not have considered placing a TV — and, in fact, can easily be transported from room to room (with the exception of the largest screen sizes) for additional flexibility. And no matter where you put them, the latest models allow uninhibited viewing from angles as severe as 170 degrees off-axis.

Considerations

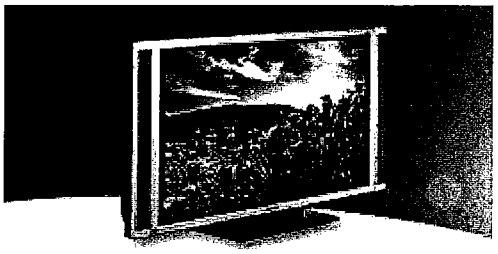
Due to its transmissive technology and the unintended leakage of some light to the display, LCD's high brightess comes at the expense of deep blacks; hence, its typical contrast ratio cannot match those produced by direct-view or even DLP sets. Early iterations of the technology had relatively slow "refresh rates," causing slight but noticeable blurring or smearing of fast-moving images; however, the advent of advanced LCD variants like active-matrix TFT panels has greatly improved performance. Likewise, technological improvements continue to reduce the occurrence of the "screen-door effect" caused by the distance between the pixels in an LCD display, but it's still more apparent with LCD than with LCOS, DLP or plasma displays.

The bottom line

When it comes to flat-panel HDTV displays, the choice between LCD and plasma is a matter of personal taste. Each has its advantages and disadvantages, and each is relatively expensive but coming down in price. Consider the information, but most importantly, visit a Best Buy store to compare displays and decide which you prefer.

CLOSE

Plasma



Plasma displays function differently than any other TV technology in that they actually produce light independently at each pixel on the screen, as opposed to projecting a separate light source through or off of other elements to conjure a picture. A plasma "screen" is actually a dense network of individual cells, three for each pixel of the display (coated with red, green and blue phosphors, respectively). Each cell is impregnated with a rare-gas mixture and connected to an individual electrode. When the electrode for a given cell is charged with an electrical voltage, the gas is converted to a plasma state and emits a burst of ultraviolet light; this in turn causes the phosphors to react and produce bright visible light at the pixel level. By varying the voltage and intensity of the electrical charge, the proper combination of red, green and blue light is produced in each pixel to combine into a bright, colorful composite image. Plasma TVs are available in sizes from about 40" up to 70"+, but be prepared for sticker shock as your size desires increase.

Strengths

Obviously, plasma TVs are desirable for their sleek form factor — about 4" deep and wall-mountable, they're undeniably sexy. Furthermore, plasma produces a very bright image that can be viewed in a well-lit room, with superb color accuracy and saturation. It's a matter of opinion, but many videophiles regard plasma's color vibrancy as beyond compare among current technologies. Because the light is produced at the screen rather than projected onto it, focus is consistent and reliable across the entire screen surface, and plasma screens can be viewed from angles as severe as 160 degrees off-axis without detrimental effect. And plasma's accurate pixel structure produces a picture that is geometrically perfect from edge to edge and corner to corner, with uniform light output and a crisp, lifelike image.

Considerations

Due to the direct way it produces light, plasma can be especially susceptible to burn-in from static images such as stock-tickers and video-game gauges; however, newer displays have begun to incorporate "pixel-orbiting" technologies that shift images, almost imperceptibly, to limit the occurrence of burn-in. Additionally, although known for their high contrast (relative to LCD) and spectacular color saturation, plasma displays have historically had difficulty reproducing pure blacks. Recent enhancements have largely eliminated this problem, but sometimes at the expense of fine detail in dimly-lit areas of the picture.

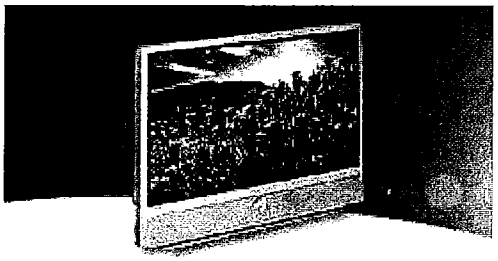
The bottom line

Overall, plasma has maintained a reputation as the no-compromise high-tech HDTV display technology. While that's not entirely accurate, there's no question that a plasma TV on your living room wall will deliver amazing video performance – and, quite likely, a parade of drooling friends through your door as well.

BEST BUY

CLOSE

DLP



DLP stands for Digital Light Processing, a unique projection technology developed by Texas Instruments and based around a proprietary semiconductor called a digital micromirror device (DMD). A single high-intensity light source is reflected off the DMD, which modulates the light by rapidly manipulating the angles of hundreds of thousands of tiny mirrors on its surface. On its way to the DMD, the light passes through a rapidly spinning color wheel that alternately filters it into red, green, blue and sometimes white or yellow spectra. By temporally coordinating the mirrors' modulations with the sequence of colors passed through the color wheel, the DLP light engine can create images with very subtle color variations, which are then magnified and projected onto a screen. For a more detailed examination of DLP technology, see our in-depth primer. DLP projection TVs come in screen sizes of approximately 42" and up.

Strengths

More expensive than CRT projection systems but less costly than LCD or plasma, DLP projection sets deliver excellent picture quality. The DLP light engine is capable of very high brightness (though not as bright as LCD), so a DLP set can be viewed even in bright room conditions. The distance between the pixels on a DLP display is quite small, minimizing the "screen-door effect" (seen more prominently in LCD displays) to create a full, seamless image. Because of DLP's fine reproduction of blacks, its contrast performance is superior to any other non-CRT projection technology. The single-light-source design eliminates the convergence issues that plague CRT and some other projection systems, and limits maintenance costs (a single bulb to replace, for example).

Considerations

DLP is not as bright as LCD technology, nor as compact as LCD or plasma flat-panel models (though the typical DLP rear-projection set is much shallower than most CRT-based rear-projection systems). Additionally, certain especially sensitive viewers notice an artifact commonly referred to as the "rainbow effect," a consequence of DLP's temporal approach to color formulation. Those viewers may momentarily see the light split into its component color spectra as their eyes travel quickly from one part of the screen to another — particularly when seated close to the screen. The unlucky few will likely find this quite distracting; fortunately, most viewers won't even perceive a problem. The latest-model DLP sets incorporate improved color-wheel technology in an effort to further minimize this artifact.

The bottom line

DLP rear-projection HDTV sets offer several advantages over CRT rear-projection systems, for a modestly higher price — along with video performance that's superior in some ways to more expensive flat-panel displays. Their impressive price-to-value ratio makes them well worth considering if you're not fixated on a wall-mountable TV.

CLOSE

LCOS

LCOS (Liquid Crystal on Silicon) technology, a souped-up derivative of LCD technology, is the hot new kid on the block in high-resolution displays. Rather than passing light through a transparent LCD panel to generate an image, in LCOS displays the light is bounced off of a reflective substrate onto which liquid crystals have been applied. There are two classes of LCOS light engines: single-chip and three-chip. In a single-chip system, light is filtered through a color-wheel system similar to that employed by DLP projection systems. The sequence of colors produced is then temporally coordinated with the modulation of light by the liquid crystals, producing subtle color variations. Three-chip displays use a system of prisms to split a single light source into its red, green and blue components (analogous to the three tubes in a CRT projection system). Discrete video modulations are applied individually to the three resulting light paths, which are then recombined by another prism array to create the composite image. LCOS technology is used in displays of 50" and larger.

Strengths

LCOS' calling card is ultrahigh resolution. A typical high-resolution LCOS panel comprises 1080 pixels x 1920 pixels, making it the first fixed-pixel imaging system capable of faithfully reproducing every detail in a 1080-line image (LCD and plasma HD panels typically "scale," or interpolate, 1080-line images in order to display them in the panels' 1024 actual lines). Additionally, among current technologies, LCOS is uniquely capable of upconverting a 1080-line interlaced image (1080i) for true progressive-scan display (1080p). Visible pixelization (known as "screen-door effect") is virtually eliminated at normal viewing distances with LCOS, because the cell structure of the panels features very little space between the individual pixels. And because the light passes through the liquid crystals twice on its way to the projection lens (once between lamp and mirror, and once more when reflected back toward the projection lens), LCOS improves upon the traditionally marginal contrast performance of LCD displays, while sharing LCD's imperviousness to burn-in.

Considerations

Because they generate color in much the same way as DLP projection systems, single-chip LCOS systems can share DLP's problem of "rainbow effect" artifacts. Most viewers won't even notice this anomaly, but to those sensitive few who do, it can be a real distraction. Conversely, 3-chip LCOS systems avoid the rainbow effect, but rely on very precise calibration in the manufacturing process to accurately recombine the color components into a sharp, seamless on-screen image. Since such calibrations are inherently imperfect (if only to a miniscule degree), 3-chip systems may suffer very slightly in the sharpness category – but since the light is separated and recombined by a fixed prism system, periodic user calibrations to maintain convergence are unnecessary. As with traditional LCD technology, pure, inky blacks are a weakness of LCOS displays, — but as with LCD, recent refinements have improved LCOS' performance in this area.

The bottom line

Overall, LCOS earns its pervasive buzz as a technology that may be the heir apparent to CRT projection for large-screen TVs, both high-definition and standard-definition. Its many advantages are balanced by bulk (cabinet dimensions similar to DLP units — slimmer than CRT projection but not as sleek as LCD and plasma) and weight (several hundred pounds is not uncommon). But if you want to feel like you're "looking out a window" while viewing your big-screen HDTV, LCOS' ultrahigh resolution and virtually invisible pixelization may be your dream come true.

LEARN MORE...

HDTV

A look at HDTV.

You probably already know that HDTV or High Definition TV has a far better picture than traditional TV. In fac times better. But what makes the picture so much better? Two things. First, HDTV is digital with all the clarity improvement you enjoy in other digital sources like DVDs or CDs. Second, the HDTV signal carries a lot more which means a far better picture. If a traditional TV signal is a one-lane road carrying information into your hor a six-lane highway. It's even broadcast in a widescreen format or 16:9 aspect ratio with surround sound to loo like the movies. It is the combination of more information and a digital signal that requires one of today's digita order to display the signal.

There are two different signals HDTV and EDTV. EDTV (Extended Definition) is a widescreen or standard screen format that has a very picture far exceeding DVD quality and offers either digital surround sound or digital stereo sound. HDTV (High Definition) is a widescree displays the highest quality picture available and offers digital surround sound. Again, looking at digital television as a six-lane highway, High Definition uses all six lanes. EDTV may only use three lanes, freeing up the other lanes for different broadcasts, like the same sho different language. If you have an ED television, you will still be able to view HD programming, just not at the full HD quality.

Now that you know how great HDTV is you probably want to know what you need In order to get it. First, you need a digital television. Even if your digital television doesn't have true HD display capabilities, it will still be able to display all digital signals. You'll also need a tuner. This is the device that reads the digital signal and converts it for display. Increasingly, digital TVs have a tuner built in. They're called "integrated." However, many digital televisions still require a separate tuner much like a cable box. If you already have a tuner the best way to enjoy HDTV programming is through over-the-air broadcasts. They can be accessed by connecting an antenna to your tuner, but these are not yet fully available in all communities.

HDTV is also available through satellite subscription services like DIRECTV as well as cable in some markets. Currently several channels' are available in HD including HBO, Showtime, Discovery HD Theater, ESPN and HDNet.

Related Products

> Glos

SONY
42" PLASMA WEGA HDTV TELEVISION
SONKDE42XBR950
It's hard to eclipse the outstanding style statement of SONY's 42" XBR Plasma with built-in HDTV tuner makes, but its vivid and bright digital picture does just that

ZENITH
15" LCD HDTV MONITOR
ZENL15V26C
ZENITH used their imagination in creating this versatile 15" LCD HDTV Monitor that can switch from a PC monitor to TV at the touch of a button

SAMSUNG
27" HDTV MONIT
SAMTXN2775HF
SAMSUNG adds c quality sight and s creation of their 27 DynaFlat™ HDTV featuring Pro Pictu Video Correction

HDTV.CNET.COM: CNET EDITORS' GUIDE TO HIGH-DEFINITION TV

The ultimate TV buying guide

Whether you want a new bedroom set or a massive home-theater centerpiece, our CNET editors' guide gives you the full picture on shopping for a new TV.

HDTV boot camp

Since the first HDTVs appeared in 1998, high-definition television has been on the mind of every TV buyer. The big question is whether now is the time to pay a few hundred to a few thousand dollars more and take the plunge on an HDTV set. We can't answer that question for you, but we can provide some basic information that may help you decide.

Analog, digital, and HDTV

Analog: An analog TV cannot display progressive-scan DVD or HDTV; it can show only standard-definition programs such as those found on regular TV, cable, or satellite--including digital cable and DirecTV or Dish Network.

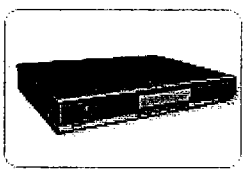
Digital: A digital television, sometimes called a DTV, can also display progressive-scan DVD and almost always HDTV.

HDTV: High-definition televisions, or HDTVs, can display standard TV, progressive-scan DVD, and HDTV signals.

EDTV: This stands for Enhanced-Definition TV, and usually it describes a television that can display HDTV signals but doesn't have enough resolution to really do them justice. Most often it applies to plasma TVs and denotes 852x480 pixels (see below).

HDTV tuners

Very few HDTVs actually come with a built-in tuner that can receive high-definition programs. Those that do are called *integrated HDTVs*, and those that don't are sometimes called *HDTV ready* or *HDTV compatible*; mostly they're all lumped together under the name HDTV. If you buy an HDTV-ready set, you'll also need to buy a separate tuner--for satellite, cable, or over-the-air reception--to watch high-definition programming. External HDTV tuners currently cost at least $600, although some cable operators are offering HDTV-capable tuners free of charge.



Zenith's HDR230 is an HDTV tuner with a

built-in hard drive recorder.

HDTV resolutions

Resolution, or picture detail, is the main reason why HDTV programs look so good. The standard-definition programming most of us watch today has at most 480 visible lines of detail, whereas HDTV has as many as 1,080. HDTV looks sharper and clearer than regular TV by a wide margin, especially on big-screen televisions. It actually comes in two different resolutions, called 1080i and 720p. One is not necessarily better than the other; 1080i has more lines and pixels, but 720p is a progressive-scan format that should deliver a smoother image that stays sharper during motion (for more on progressive scanning, see our primer). Check out our comparison chart to see how HDTV stacks up against standard TV and progressive-scan DVD.

Name	Resolution	HDTV?	Wide-screen?	Progressive-scan?
1080i	1,920x1,080	Y	Y	N
720p	1,280x720	Y	Y	Y
Wide-screen 480p (DVD)	852x480	N	Y	Y
Regular TV	Up to 480 lines	N	N	N

Videophiles are quick to point out that not every HDTV can actually display all the resolution of an HDTV program. That's true; all but the most expensive sets with 9-inch CRTs and LCoS engines are incapable of resolving every detail of 1080i material. Plasma, LCD, LCoS and DLP TVs have a fixed number of pixels, known as *native resolution*, and the higher that number, the more detail you'll see. Naturally, higher-resolution fixed-pixel displays cost more money. At the end of the day, however, even the staunchest video critics will admit that a high-definition picture on any HDTV looks far superior to regular TV.

Regular TV and DVD on an HDTV

Regular TV on an HDTV: Aside from being able to display high-resolution HDTV shows and movies, a high-definition set can also make regular TV look a little better. Almost every HDTV has a processor that takes the regular TV image and converts it to progressive-scan for a more stable image. This conversion won't work miracles, however, and many HDTV buyers are disappointed by how regular television looks on their new sets. That's because the big screen exaggerates the flaws in standard TV programs. No matter how nice a TV you buy, there isn't much you can do to make regular TV, including digital cable or satellite, look better.

DVD on an HDTV: Since most people don't buy HDTV tuners and converted TV doesn't really leverage the full potential of a new high-def television, you may wonder why people buy HDTVs today at all. Most of them will probably tell you it's because of DVD. HDTVs can make DVD, a very high-quality source, look spectacular. Progressive-scan DVD players have their own internal processors that are generally superior to the ones inside most digital sets. Mating a prog-scan DVD with an HDTV will give you the best picture you can get outside of HDTV itself.

Your HDTV tomorrow

If you buy an HDTV today, you can be fairly certain it won't become obsolete anytime in the next few years. There is a possibility, however, that Hollywood studios will enforce some sort of copy protection on analog HDTV connections; a move is underway to "plug the analog hole." Your safest bet is to get an HDTV with a DVI/HDCP or HDMI connection (see Inputs and outputs). They're the most future-ready HDTV connectors currently available.

▸ **Wide-screen vs. 4:3**

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The ultimate TV buying guide

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Size up your screen

The first thing you need to decide is how large a screen you want. Usually, the largest screens cost the most, but regardless, the TV should deliver the right-size picture for where you'll sit relative to the screen. Sitting closer to a smaller TV means you won't have to spend as much on a big screen. But if you sit too close, the picture will look poor.

Regular TV-viewing distances

Most viewers feel comfortable sitting away from the set at a distance that's between three and six times the width of the screen. The following chart can give you a rough estimate of the minimum and maximum viewing distances for regular televisions.

4:3 TV diagonal screen size	Min. viewing distance (in feet)	Max. viewing distance (in feet)
13	2.6	5.2
19	3.8	7.6
20	4	8
24	4.8	9.6
27	5.4	10.8
32	6.4	12.8
36	7.2	14.8
40	8	16

Wide-screen TV-viewing distances

You'll notice that we said *regular* televisions. Wide-screen televisions showing high-resolution DVD

and HDTV look better than regular sets, allowing you to sit closer and experience a more immersive, theaterlike picture.

With wide-screen sets showing DVD or HDTV, you can sit as close as 1.5 times the screen's diagonal measurement and not notice any loss in quality, while sitting farther away than three times the screen size means you're likely to miss out on the immersive feel. Here's a rundown of minimum and maximum recommended viewing distances for wide-screen sets.

16:9 TV diagonal screen size	Min. viewing distance (in feet)	Max. viewing distance (in feet)
26	3.3	6.5
30	3.8	7.6
34	4.3	8.5
42	5.3	10.5
47	5.9	11.8
50	6.3	12.5
55	6.9	12.8
60	7.5	15

Size and your room
Generally, 13-, 19-, 20-, and 24-inch sets are great for bedrooms or guest rooms but too small for the main living room. Sets with 27-inch or bigger screens are large enough for the whole family to enjoy and will probably be too much for most small bedrooms. Remember that tube TVs are also fairly deep and get bulkier as the screen size increases. You'll want to pick out a deep-enough spot for the TV so that it doesn't protrude awkwardly into the room.

If you're mounting the set inside an entertainment center, be sure it fits in every dimension; also, leave an inch or two on all sides so that the TV has enough ventilation. If you're getting a bigger set, you may want to consider a dedicated stand; many TV makers sell matching stands that increase the aesthetic appeal of their hefty boxes.

Screen sizes and display types
Most televisions have screens that measure 13, 19, 20, 24, 25, 27, 32, or 36 inches diagonally. Sony does make a 40-inch tube, but after that, TVs switch from standard tubes to rear-projection or plasma models. These different TV types have their own strengths and drawbacks, which we detail in CNET's quick guide to TV types.

› **HDTV boot camp**

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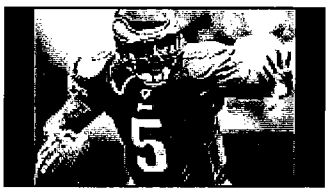
Wide-screen vs. 4:3

Television screens today come in two shapes. The most familiar one is called 4:3, which represents four inches of width for every three inches of height. You can also buy wide-screen, or 16:9, televisions, which take the same shape as many movies. Wide-screen sets cost more per square inch of screen than standard TVs, and most people watch more regular TV than DVDs and movies, so 4:3 sets are the overwhelmingly popular choice.

But if you have $1,000 or more budgeted toward your next TV, you should seriously consider going wide. With huge numbers of anamorphic DVDs and the appearance of more wide-screen TV and HDTV shows, there's plenty of wide-screen content out there, and even more will appear in the future.

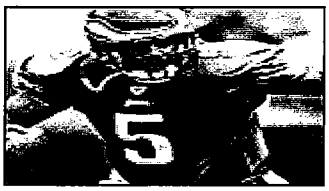
Black bars and unused screen
Many people choosing between 16:9 and 4:3 TVs wonder how much picture they'll be missing when viewing differently shaped programs. DVD and other wide-screen video shown on a standard TV have black bars, known as *letterbox bars,* above and below the wide-screen image. Conversely, regular programs shown on a wide-screen TV have windowbox bars on either side of the picture.

Wide-screen TVs and 4:3 programs
All wide-screen TVs have ways to stretch, crop, or zoom the regular 4:3 image so that it fills the screen. These methods distort the image somewhat, but many wide-screen TV owners prefer looking at slightly stretched people rather than windowbox bars. Here's a quick rundown of the different names for selectable aspect-ratio modes found on 16:9 sets:

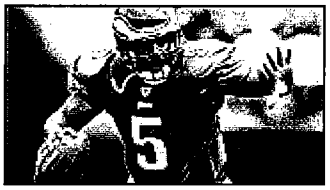


Normal or 4:3: Places windowbox bars on either side of the 4:3 screen.

Zoom or Enlarge: Magnifies the entire image, eliminating the windowbox bars but cropping the top and bottom of the image. Often, more than one level of zoom is provided.



Wide or Full: Used for native 16:9 content such as that found on DVDs. With 4:3 content, such as regular TV, it stretches the image horizontally, making people look shorter and fatter.



Panorama, TheaterWide, or Natural: TV makers have many names for modes that compromise between stretching and zooming to fill the screen. Some stretch the sides of the image more than the middle, so people in the center of the screen look correct. Some crop a little so that they don't have to stretch as much.

Key features and connectivity options

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The ultimate TV buying guide

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Judging picture quality

The most difficult thing to judge when shopping for a TV is how good the picture looks. *Good* is a subjective term, so relying on the judgment of reviewers (such as CNET) may not get you exactly what you want. Then again, many reviewers scoff at the kinds of pictures that impress TV shoppers in the store. In this section, we'll offer some tips on become a more discerning viewer and what separates good pictures from the rest.

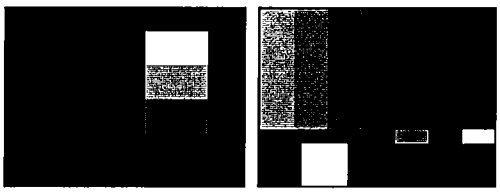
The wall of tubes

Most electronics stores show their televisions on a big wall, fed by the same video signal split a hundred times. Although bright lights, suspect salespeople, and a lack of remote controls will probably make any picture-quality judgment difficult, here are a few things to look for on the wall.

- **Don't fall for brightness.** Almost every television on the sales floor is set to the brightest picture settings, so try to get the salesperson to reduce the controls of the TVs you're comparing. You want the pictures--not necessarily the controls--to be roughly equal in brightness, contrast, and color.
- **Go out of the light.** Few living rooms are as well lit as the sales floor, so see if the salesperson can reduce the amount of light shining on the picture. If nothing else, try to shade the screen if light is shining directly on it.
- **BYO DVD.** If you have a DVD that you're familiar with, see if you can use it instead of the TV signal that's normally shown. DVD provides the best picture a normal TV can possibly display, so it makes for an ideal reference from which to judge.
- **Try all the picture modes.** Many sets come with numerous picture presets, such as Movie and Sports, that radically affect how the image appears. After you peruse the manually adjusted pictures, try the different presets and modes to see which ones look best.

Features that enhance picture quality
Normal analog TVs, as opposed to digital TVs, have just a few factors that affect picture quality. Look for these features or characteristics and disregard other features that sound good on the surface but in reality are just marketing ploys. Naturally, there are other important factors we can't cover here, but this should get you started.

- **Comb filter.** If a television does not have a comb filter, its resolution will be limited to about half the full potential of DVD. Most sets with comb filters can provide all of the resolution of DVD. The types of comb filters you'll see advertised, in order of lower to higher quality, include two-line, three-line, digital, and 3D YC varieties. They provide incremental improvements in performance, especially in reducing rainbows that can appear in fine detail, such as a talking head's suit coat. Comb filters affect only composite-video or RF connections (see Inputs and outputs).

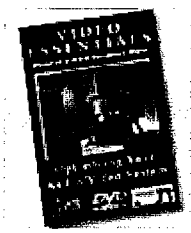


- **Color-temperature settings.** Many televisions have presets for color temperature, which is basically the color of gray. A neutral gray is ideal, but most TVs have an extremely blue gray to make the picture brighter in the store. TVs with color-temperature presets allow you to choose the color of gray; generally, you'll want the reddest or lowest setting available.

- **Color decoder.** Most TVs' color decoders are set to be too red to counteract the blue color temperature described above. TV makers don't advertise accurate color decoders, so you'll have to judge for yourself or trust a reviewer. In the store, look for pale skin tones that don't appear too flushed and reds that don't bleed into other colors or otherwise seem more intense than the rest of the palette.

- **Geometry and convergence.** Most TVs get bumped around in shipping, so it pays to check convergence before you take yours home--or at least before the warranty expires. Look toward the edges of the screen, preferably with graphics or other straight lines (CNN's crawling ticker works great), and see if the lines are actually straight. To check convergence, look at the corners with white material, preferably lines again, and see if faint halos of color surround the white.

Calibration



You'll often see CNET reviews mention calibration or the ISF. When they look at high-end televisions, our writers access a service menu using codes that aren't available to the average consumer, and they use that menu--along with specialized equipment such as color analyzers--to calibrate the TV for optimal display of video according to NTSC standards. The Imaging Science Foundation, or ISF, has a program that trains professionals to calibrate televisions, and for a few hundred dollars, you can retain an ISF professional to adjust your TV.

Alternatively, you can use a calibration DVD to help you adjust the television. These discs, such as Ovation Software's *Avia,* Joe Kane's *Video Essentials,* and Sound & Vision's *Home Theater Tune-Up,* show you how to optimize your set within the limits of the standard user-accessible menus.

› Video gaming and computer tips

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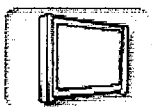
Fat or flat: 4 styles of HDTV

By David Katzmaier
(March 18, 2003)

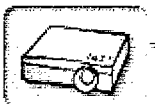
Once upon a time, when only analog, tube TVs were around, buying a new set used to be a whole lot less of a nerve-racking experience. Now, there are all sorts of questions. Do you go wide or not? Is LCD better than plasma? And what's the difference between new rear-projection LCD, LCoS, and DLP HDTVs? If all the tech jargon has you confused, don't worry. Read our guide to the pros and cons of new, high-tech TVs, and you'll feel a whole lot more confident when you hit your local electronics store.



Direct-view (tube) TVs
What's new with the tube.

Flat-panel TVs
Slim is in, but plasma isn't LCD. Learn the difference.

Rear-projection TVs
Big-screen boxes come in many flavors. Taste them all.



Front-projection TVs
Prices for projectors are way down, and the images are getting better.

Show me direct-view (tube) TVs

HDTV.CNET.COM: CNET EDITORS' GUIDE TO HIGH-DEFINITION TV

Fat or flat: 4 styles of HDTV

Direct-view (tube) TVs

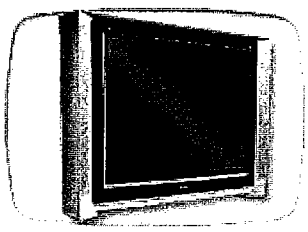
Upside: Relatively inexpensive; excellent picture quality; wide viewing angle; long life; can be viewed in brightly lit environments.

Downside: Bulky and heavy; limited screen size.

Forecast: These sets are still going strong, but their end is in sight.

Direct-view is how industry insiders refer to any television that doesn't use projection technology. Most of them are the familiar tube TVs you see everywhere--they're called *tubes* because the glass forms the business end of a cathode-ray tube (CRT). Direct-view tube TVs can be found in sizes up to 40 inches diagonal, and as their screen sizes increase, so does their heft and depth. Sony's 40-inch model, for example, tips the scales at more than 300 pounds, measures 26 inches deep, and requires a minimum of two--and probably three--burly guys to lift it onto a stand. Because of size and weight issues, it doesn't pay for companies to make larger tube TVs; they simply aren't practical.

High-end tube TVs can give a great-looking picture. CRTs are still the kings of *black level,* a term used to describe the quality and the depth of black and other very dark colors. Direct-view tube sets look good from any angle, so the picture quality doesn't change depending on where you sit. These TVs can also be viewed in brightly lit rooms and last 5 to 10 years with only a minimal loss in picture quality.



Sony's 40-inch KV-40XBR800

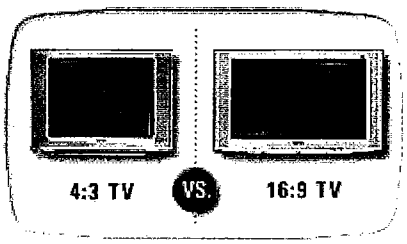
New developments:

Flat vs. curved screen: The traditional curved shape of the glass tube is giving way to completely flat glass. Sony introduced flat tubes first with its WEGA televisions, but now, just about every manufacturer sells some kind of flat-tube TV. Flat glass not only looks more high-tech, it collects less ambient light from the room and, therefore, helps to reduce glare. But it's a myth that flat tubes result in straighter lines; they can have the same geometry problems as their curved counterparts, especially near the corners and the edges of the screen.

Digital vs. analog: The majority of tubes are still analog, meaning that they won't work with high-definition tuners or progressive-scan DVD players. On the other hand, most digital TVs can display both progressive-scan DVD (480p) and HDTV (usually 1080i); we call these sets *HDTVs.* Digital TVs have higher resolutions and cost more than analog sets. Some of the priciest digital models include a built-in tuner for HDTV, but most require you to purchase a separate tuner.

Wide-screen 16:9 vs. standard-screen 4:3: For the strongest theatrical impact, the majority of movies are filmed in the wide-

screen format, where the screen is much wider than it is tall. Regular televisions and most TV programs use a narrow-screen, 4:3 *aspect ratio,* which refers to the width of the screen compared to its height. Newer TVs--especially HDTVs--often have screens with a much wider ratio: 16 units of width for every 9 units of height, which translates to a 16:9 aspect ratio. Wide-screen, direct-view TVs cost quite a bit more than 4:3 models for the same amount of screen real estate, but they're great if you watch a lot of DVDs or HDTV.



‣ Flat-panel TVs

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Fat or flat: 4 styles of HDTV

Flat-panel TVs

The biggest television-technology revolution since color, flat-panel TVs will eventually replace tubes as the direct-view televisions of choice. You can hang flat sets on the wall, on the ceiling, or above the mantle in place of a trophy buck. The two major players in the flat-panel game are plasma and LCD, so we'll go over each type separately. Note: Almost all plasmas--and many LCDs--are *HDTV-capable,* meaning that they can accept a high-definition signal. However, many of these sets don't have enough pixels to display the full resolution of HDTV.

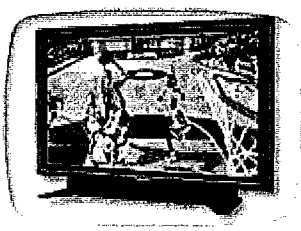
Plasma
Upside: As little as three inches thick; potential for very large screen size; wide viewing angle; often computer-display capable.

Downside: Expensive; only average black level; potential for burn-in.

Forecast: Prices have fallen a bit and pictures have improved dramatically, but don't expect to see affordable plasmas for a few years to come.

With prices starting at around $2,500, plasma technology unsurprisingly has the reputation of being a plaything of the rich. If you can swallow the payments, however, you'll get a sexy, flat-panel TV with a picture that's nearly as good as that of a CRT. The word *plasma* refers to the gas trapped inside every pixel, which lights up when an electric charge is applied.

Despite significant, recent advances, plasma panels still can't replicate the deep blacks that tubes can. A handful of today's top-rated models come pretty close, though, and as the technology matures, we expect to see more plasmas with good black-level performance.



Panasonic PT-42PD3-P

You may have heard that plasma has a couple of drawbacks. One such downside is called *burn-in,* which occurs when an image--such as stock ticker or a network logo--gets etched permanently onto the screen because it sits in one place too long. However, if you take a couple of preventive steps, the risk for burn-in can be greatly diminished. As long as the contrast control is kept to a reasonable level (we recommend 50 percent or less), and the user avoids showing static images on the screen for hours at a time, a plasma screen should not burn in. Newer panels also have burn-in-reduction features that further reduce this possibility.

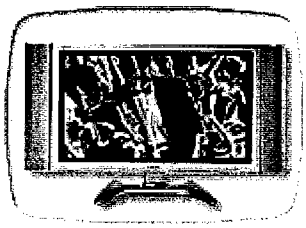
The life span of a plasma TV is probably not as good as that of a CRT, but these panels still last quite a while. According to LG Philips, the typical plasma has a life span of 20,000 to 30,000 hours, which equates to at least two years, three months of 24/7 usage before the panel fades to half brightness.

LCD
Upside: As little as two inches thick; very bright picture; no danger of burn-in; long product life span.

Downside: Expensive; screen sizes are relatively small; below-average black level.

Forecast: Prices on this technology should fall precipitously over the next couple of years, following the computer LCD trend. We think that big-screen LCDs will soon threaten plasmas.

Think of flat-panel LCDs as plasma's smaller, less attractive, tougher brother. Currently, its screen size tops out at around 37 inches, although larger prototypes have been shown. LCD also hasn't come as close as plasma has to reproducing true blacks. On the other hand, LCD prices will drop quickly as manufacturing potential increases and new plants are built.



Sharp's Aquos LCD set

LCDs are generally brighter than plasmas and, therefore, look better in well-lit rooms. They're also immune to burn-in and have longer life spans: 50,000 hours according to LG Philips. These factors mean that in a few years, LCD could really challenge plasma in the larger-screen-size arena. For now, however, large, flat-panel LCDs are even more expensive per square inch of screen than plasmas.

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Fat or flat: 4 styles of HDTV

Rear-projection TVs

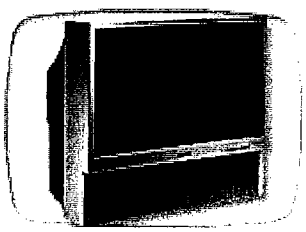
Thinking of going big? Sure, you could buy a 63-inch plasma, but most people who want to maintain a good credit rating will opt for a rear-projection television (RPTV) instead. These sets start at about 40 inches diagonal, and the majority of them support the wide-screen, 16:9 aspect ratio and can accept high-definition signals. Here's an introduction to the choices.

CRT
Upside: Relatively inexpensive; excellent picture quality in a proper environment.

Downside: Deep cabinets; need periodic maintenance; not ideal for bright rooms; narrow viewing angle.

Forecast: Among all CRT-based displays, these will be the first to go the way of the dodo.

Manufacturers still sell tons of CRT-based HDTVs, but over the next couple of years, other technologies will fall in price, and we'll witness their extinction. Tube-based RPTVs are not as bright as the other technologies described below and require regular convergence adjustments to maintain alignment of the red, the green, and the blue CRTs. Many such sets also suffer from relatively narrow viewing angles, where the picture becomes dimmer and/or discolored when you watch from any angle other than straight ahead.



Mitsubishi's WT-42311

Relatively low prices will keep CRT-based big-screens in the game for the moment, and some advances in the field have been made. Manufacturers are finally developing smaller, slimmer versions, although they're still bulkier than the alternatives. CRTs also offer the highest picture quality, including those elusive blacks, of any rear-projection technology--provided that you watch in a relatively dim room on a well-adjusted set.

DLP
Upside: Good black-level performance; no maintenance required; HDTV-capable resolution.

Downside: Expensive; some rainbow effects; lower resolution than that of LCD.

Forecast: As the most common CRT-replacement technology, DLP has an early advantage on LCD and liquid crystal on silicon (LCoS); the future looks bright.

We've been talking about black levels a lot, so let's finish the discussion right here: Aside from CRT models, digital-light-processing (DLP) sets currently provide the best blacks of any projection technology. DLP-based RPTV also have a 1,280x720-resolution chip that shows every pixel of 720p

HDTV, resulting in a very sharp picture that doesn't need to be adjusted periodically. That's not as much resolution as you'll get from some LCD-based rear-projectors, however.

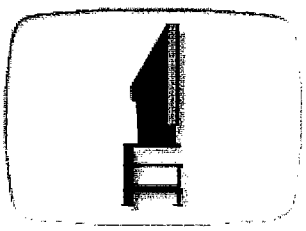
One potential problem with DLP sets is known as the *rainbow effect.* Some people can see streaks of color on these TVs, especially when moving their eyes across the screen. The occurrence of these rainbows has been significantly reduced with the advent of newer, faster color wheels, which are used to separate the internal lamp's light into color before it hits the chip. In terms of price vs. performance, DLP leads the pack of CRT replacements for the moment.

LCD
Upside: High resolution; no maintenance required; very bright picture; slim design.

Downside: Expensive; historically poor black-level performance.

Forecast: The competition's high performance may prove too much, but for the here and now, LCD stays strong.

Sony's Grand WEGA sets, including the 60-inch KF-60XBR800, stand as good examples of LCD rear-projectors. The aforementioned ultraslim, big-screen model has an even higher resolution (1,366x768) than DLP sets, and its three-chip color engine allows for excellent saturation. The TV is also very bright, so watching in a well-lit room isn't a problem.



Slimmer box: LCD and LCOS RPTVs

That said, the KF-60XBR800 also suffers from unimpressive black-level reproduction. LCD works by transmitting light through the chip, much like a photographic slide, so some light always gets through and makes for less than ideal blacks. We've witnessed significant improvement in the black levels of LCD front-projectors, so it will be interesting to see if newer RPTV versions follow suit.

LCoS
Upside: Very high resolution; no maintenance required; slim design.

Downside: Expensive.

Forecast: It's too early to tell for sure, but LCoS has the potential to outstrip LCD and DLP in both performance and value.

Only a few LCoS TVs are available today, including the Toshiba 57HLX82 and a couple of models from Philips. This relatively new technology has great promise because it allows for even higher resolutions than regular LCDs. The Toshiba set has a 1,920x1,080 resolution--high enough to display all the detail in a 1080i HDTV picture--are possible using LCoS. Unfortunately, early examples are even more expensive than DLP and LCD. We haven't officially reviewed any LCoS TVs yet, but stay tuned.

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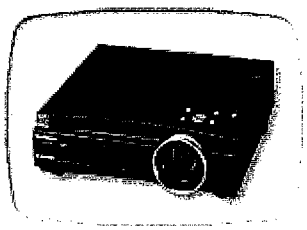
Fat or flat: 4 styles of HDTV

Front-projection TVs

At the top of the screen-size ladder, you'll find displays that don't really qualify as TVs: front projectors. These light cannons can easily fill 100-inch screens, but they're not for everybody since they require a light-controlled environment and plenty of room. Plus, for optimal picture quality, you'll want to buy a dedicated screen, although you can use a white wall in a pinch. Screen makers such as Da-Lite and Stewart have special, low-gain screens designed to improve black-level performance for LCD and DLP projectors.



Panasonic's PT-L300U projector

CRTs are also used in front-projectors; think of those three-tube monstrosities that hang from the ceiling in the coach compartments of older airplanes. We won't discuss them here, however, namely because CRT projectors are quite expensive and are generally reserved for high-end, custom installations, where they put the local cineplex to shame.

DLP and LCD projectors, on the other hand, often cost much less than their rear-projection cousins. Both technologies project the kind of huge picture--from units as small as a shoebox--that you enjoy at the theater.

DLP
Upside: Good black-level performance; smaller and lighter than LCDs.

Downside: Lower brightness than that of LCDs; rainbow effect.

Forecast: More and more manufacturers are leaning toward DLP--especially among inexpensive models--so prices will continue falling.

Much like rear-projection models, front-firing DLP projectors beat out LCDs when it comes to making inky blacks. On the flip side, they're not quite as good at filling large screens with light, so you may want to choose LCD if you're using the projector mainly for presentations. A few viewers may also see the rainbow effects that we described in the DLP rear-projection section.

The least expensive DLP projectors use SVGA-resolution chips (800x600). That resolution is not high enough to display full HDTV, but it's nearly sufficient to capture every line of wide-screen DVD, which calls for 852x480 resolution. In practice, most of these models look well detailed with both HDTV and DVD. Step-up sets offer 1,024x768 or even more expensive 1,280x720 resolutions, for a corresponding increase in detail. However, only the 1,280x720 versions can display every detail of 720p HDTV, and their 16:9 aspect ratios are tailor-made for home theater.

LCD
Upside: Very bright picture; good color fidelity.

Downside: Expensive; poor black-level performance.

Forecast: The advent of cheap DLP models is forcing LCD to improve in every regard, as well as drop in price.

LCD and DLP are very close in terms of performance, and even LCD's ability to produce good blacks--often expressed as a contrast ratio in projector specs--has improved quite a bit. DLP still enjoys a slight edge, however, balanced by LCD's generally higher light output. LCD's *color fidelity* (its ability to produce rich, saturated colors) can also beat that of DLP in some cases. LCD projectors offer a similar selection of resolutions as DLP models, although higher-end projectors use 1,366x768 LCD chips.

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Three ways to get HDTV programming

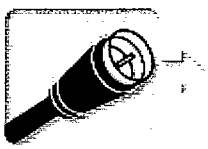
By Ben Patterson
(December 1, 2003)

After years of hype, HDTV has finally reached the tipping point. Prices for HDTV sets have fallen to less than $1,000; the three big broadcast networks offer almost all of their prime-time shows in high definition; and HDTV signals are readily available, either over the air or via cable or satellite.

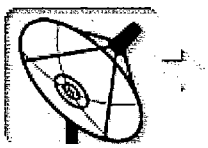
Available HDTV signals are all well and good, but enjoying them in your home still takes some doing. Most high-definition TV sets won't decode over-the-air HD signals without a separate, expensive tuner. Cable and satellite providers don't carry all of the available networks. And while almost all network TV dramas and comedies are in HDTV, you might find that your favorite show (*24,* anyone?) is still stuck in standard-definition limbo.

Read on to learn what equipment you'll need to get HDTV into your living room--once you have an HDTV set, of course. We'll help you find over-the-air, cable, and satellite options for HDTV, and we'll give you a taste of which shows, sporting events, and specials you can expect to see in high definition.

Antenna
Prepare to climb up on the roof if you want to take advantage of free, over-the-air HDTV.



Cable
Your cable provider may be the answer, and in some cases, the HDTV receiver is free.



Satellite
Dish Network, DirecTV, and now Voom have all gone high-def, but the equipment will cost you.

Antenna

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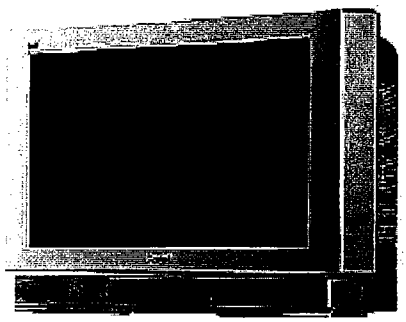
HDTV explained

Most sets on the market are HD-ready sets. Often called monitors, such sets must be connected to an external tuner to receive HD and other digital TV (DTV) signals.

An HD-ready set can receive standard-definition programs (most TV shows) on its own, but requires one of the following to display HD fare:

To get off-air reception: A rooftop antenna and an external digital decoder ($400 or so).
To get HD via cable: A digital cable box that supports HDTV.
To get HD via satellite: A dish and receiver combination that supports HD. (Some satellite receivers also accept off-air input from a rooftop antenna.)

Integrated HDTVs with built-in digital tuners are less common and more costly. They can display HD on their own from a roof antenna, but they still need a special box to get HD via cable or satellite. We tested one 36-inch model, the *Zenith C36V23*, $2,000, which was very good overall.



Panasonic CT30WS52

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"Aspect ratio" explained

Most regular TV sets come in an aspect ratio of 4:3, while most direct-view HD sets come in two shapes, or aspect ratios: the familiar squarish shape (called 4:3, meaning 4 units wide for every 3 high), and the newer wide-screen shape similar to that of movie-theater screens (16:9, meaning 16 units wide for every 9 high). The direct-view CRT 4:3 sets we tested are the typical 27-, 32-, or 36-inch screen sizes (measured diagonally). The wide-screen models we tested are 30 or 34 inches (measured diagonally). HD-ready rear-projection TVs, LCD, and plasma displays are usually 16:9 and come in a range of sizes.

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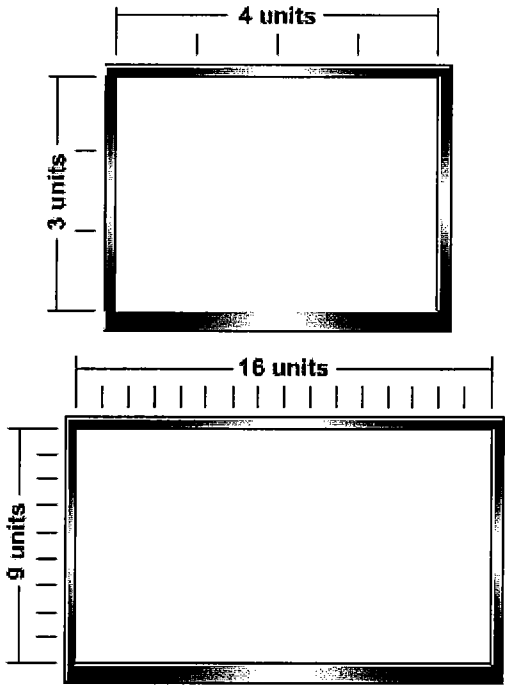

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"Aspect ratio" explained

TV programming, including made-for-TV movies, is usually formatted for a 4:3 screen. Most cinematic movies are made in 16:9 format; more TV fare is adopting this format as well. Content that is formatted for one type of screen has to undergo some modification to fit the other. Letterboxing puts bars to the left and right or top and bottom. Pan-and-scan moves the 4:3 window across wide-screen films to follow the action in the scene.

More >>

4:3

16:9

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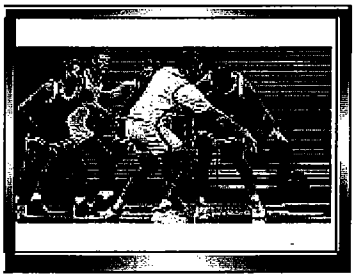
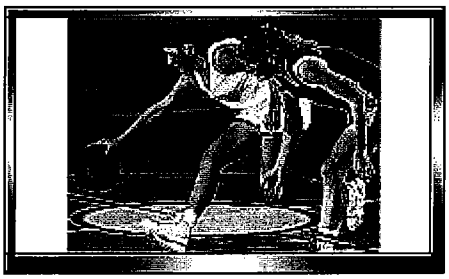
"Aspect ratio" explained

Most sets have a "stretch" mode that fits an image to a screen (a 16:9 image to a 4:3 set or vice versa) without the bars to fill the blank space. However, the picture is often distorted in the process. Many DVD movies have wide-screen and regular formats on one disc to help work around this problem.

In choosing a screen shape, consider the type of programming you'll usually watch. Given the trend toward more 16:9 programming, a wide-screen model may be the better choice down the road.





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High time for HD?

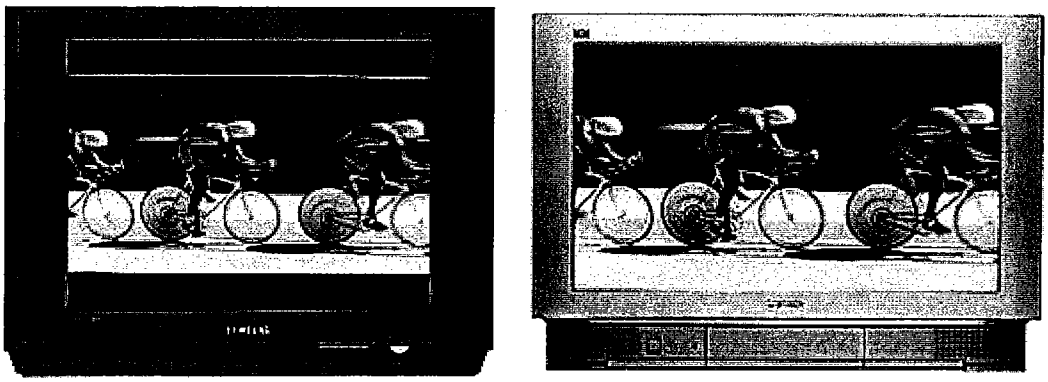
Falling prices make high-definition TV more attractive than ever.

You'll get the best picture quality when you pair the TV with an HD signal from an antenna, cable, or satellite dish. Until quite recently, very little HD programming was available. But there's a growing body of HD content from the major networks as well as from cable and satellite channels. Even with regular TV signals or DVD movies, which might represent much of your viewing for a while to come, an HDTV's picture will almost certainly be better than a regular TV's.

With prices on HD sets falling steadily, you may be increasingly tempted to buy one. The least expensive way to enjoy HD is with a direct-view TV. This type of set, which uses a picture tube, is essentially an enhanced version of the conventional TVs you've been watching for years. Prices for 27-inch TV sets capable of displaying HD have fallen to less than $1,000. TVs with 32- and 36-inch screens start at less than $1,500 and $2,000, respectively.

To enjoy HD content on a bigger screen, you may want to consider a rear-projection set. Those sets have screens measuring 42 to 73 inches. HD-ready projection TVs cost about $1,700 and up, but their picture quality isn't as good as a direct-view set's. (See our December 2003 report on Projection TVs.)

Here's a look at direct-view HD sets, with Ratings of 23 models ranging in size from 27 to 36 inches and in price from $750 to $2,600.



TWO WAYS TO LOOK AT IT **HD-ready sets come in two aspect ratios. The 27-inch *Samsung TXM2797HF,* $900 (above, left), is a 4:3 set best suited to conventional TV programming. The 30-inch *Panasonic CT-30WX52,* $1,800 (above, right), is a 16:9 TV better suited to wide-screen movies and HD content. Note that the 4:3 set displays bars around a movie, which fills the 16:9 screen.**

BASIC CHOICES

HD-ready sets or integrated HDTVs. All but one of the models in our Ratings are HD-ready sets, often called HD monitors. An HD-ready TV set can receive standard-definition programs (most TV broadcasts) on its own, but it requires additional equipment to display HD.

▶ **To get off-air reception:** A rooftop antenna and an external digital decoder ($400 or so).

▶ **To get HD via cable:** A digital-cable box that supports HDTV.

▶ **To get HD via satellite:** A dish and receiver combination that supports HD. Some receivers accept off-air input from a rooftop antenna.

Integrated HDTVs with built-in digital tuners are less common and more costly. They can display HD on their own from a roof antenna but typically need a special box to get HD via cable or satellite. We think HD-ready TVs are a better choice for most.

Within the next few years, all new TVs will begin incorporating digital tuners for off-air (antenna) reception, as recently mandated by the Federal Communications Commission. The goal is to eliminate the need for a set-top box to receive off-air HD programming. Premium channels, pay-per-view, and other programming may still require a set-top box, however. Even though TVs are evolving, any set you buy now will be usable down the road. At most, you may need a new cable or satellite box as standards and capabilities change.

Shape and size. Direct-view HD sets come in two aspect ratios: the familiar squarish shape (called 4:3, meaning 4 units wide for every 3 high), and the newer wide-screen shape similar to that of movie-theater screens (16:9, or 16 units wide for every 9 high). The 4:3 sets have 27-, 32-, or 36-inch screens (measured diagonally). The wide-screen TVs we tested measure 30 or 34 inches diagonally.

TV programming is usually formatted for a 4:3 screen, but more is adopting the 16:9 format. Most cinematic movies are 16:9. Content formatted for one type of screen has to be modified to fit the other, so you may see bars to the left and right or top and bottom.

Most sets have a "stretch" mode that fits an image to a screen (a 16:9 image on a 4:3 set or vice versa) without the bars to fill the blank space. However, the picture is distorted in the process. Many DVD movies have wide-screen and regular formats on one disc to help work around this.

In choosing a screen shape, consider the type of programming you'll usually watch. Given the trend toward more 16:9 programming, a wide-screen model may be the better choice down the road. However, wide-screen models generally command higher prices than their 4:3 counterparts.

Because of the picture quality of HD sets, you can sit closer to them than you can to regular TVs, which have visible scan lines that can be distracting. As a result, you can use a larger set to get a big-screen experience, even in a small room.

PICTURE, SOUND, AND MORE

Picture quality. Even with an HD set, you're likely to watch regular TV programming much of the time, so we based the scores in the Ratings on quality with standard-definition signals. We evaluated HD picture quality separately; see "Recommendations & Notes" in the Ratings.

Using the basic antenna/cable input, the picture quality with standard signals was mostly very good--better than with regular TVs. (The exception: With a poor analog signal, standard-definition programming often looked worse than on a conventional TV.) As we expected, the video improved when we switched to the S-video input, a connection that's often used with cable boxes, satellite receivers, and DVD players.

To evaluate HD picture quality, we fed HD test images through the component input, the best connection available on most TV sets and the only way to connect an HD source to these TVs. The *Panasonic, Sony,* and *Toshiba* sets we tested illustrate the very high picture quality you can get from HD. Picture quality among them was comparable, but there were some differences in color, contrast, and clarity.

Sound quality. Sound from the internal speakers was mostly very good or excellent. Those judged very good should be fine for typical TV fare. The choosiest buyers should stick with the 10 models judged excellent for sound. If you plan to run the audio out to a receiver and external speakers, the TV's sound won't be a factor.

Ease of use. As features have proliferated, it has become more of a challenge to make TVs that are reasonably easy to use. Few of the sets had remote controls or onscreen menus that were as simple to use as we'd like. For example, you should not have to drill down three or four menu levels and then press an Enter button to make a simple adjustment to picture or sound, as we did in a number of cases.

Features. HD sets tend to have high-end features, such as a flat screen, which reduces reflections, and side-by-side picture-in-picture (PIP), which lets you watch two shows simultaneously. Motion compensation is a useful feature that can noticeably improve the smoothness of movies played on standard (not progressive-scan) DVD players. This feature is sometimes called film or movie mode, 3:2 pulldown compensation, or brand-specific names such as CineMotion.

Freeze mode freezes the image on the screen, handy if you want to copy a phone number. Some sets include audio processing such as BBE, which boosts bass and treble. We found that it improved sound with music and movies. *Sony* sets have a slot for Memory Stick media, which makes it easy to view still images captured on digital cameras or camcorders.

A handful of the sets we tested have a digital visual interface (DVI) input, a connection for transmitting video signals in digital rather than analog form. The industry is beginning to use this type of connection in part to prevent what some consider unauthorized copying of HD programming and other material.

RECOMMENDATIONS

All of the tested sets have a lot to offer, including a flat screen and rich complement of features and inputs. For the best performance with both standard-definition and HD signals, go with an HD-ready set from Panasonic, Sony, or Toshiba. We tested several in each brand family; choose a model with the screen shape, features, and price that best suit you.

The other brands we tested were generally very good overall. Their HD picture quality is superior to anything you'll see on a regular set, but they didn't quite match the best performers. The *Zenith* sets had inconsistent HD image quality, especially toward the edges of the screen. Here are some models to consider:

For the lowest cost, a 27-inch set is the way to go. All the sets we tested in this size were very good, but they didn't match the larger sizes for HD performance. The 32-inch *Sony KV-32HS500,* $1,450, combines performance and value, as does the 36-inch *Toshiba 36HF72,* $1,800. In the wide-screen category, the 34-inch *Toshiba 34HD82,* $1,800, offers top performance at a comparatively low price for its type and size. A notable value among the 16:9 sets: the 30-inch *Samsung TXM3097WHF,* $1,000.

Whichever set you choose, consider home delivery. The largest sets weigh 240 pounds or more, and the box of even a 27-inch set isn't likely to fit in the trunk or backseat of the average sedan. All the tested models have an in-home service warranty.

hdtv faq's

High-Definition Television (HDTV) is the view of the future and ABC is proud to offer most of its prime time programming in this exciting new format. Here's a primer on the basics of HDTV.

What is HDTV?
High-definition television is a new format for broadcasting TV programming. The existing format is called NTSC (National Television Standards Committee) and is analog. By contrast, the signals in HDTV are digital.

Do I need a new television set to watch HDTV?
Yes. You must have a high-definition tuner and monitor to properly decode HDTV signals and display them accurately. ABC's programs are also broadcast in standard format, so today, no programs are ONLY for HDTV users. Your regular television set simply ignores HDTV signals that are being broadcast. When you want to step up to watching HDTV, you'll need to get a new high-def TV set.

What's different about HDTV versus the existing signals?
The HDTV signal is digital resulting in crystal clear, noise-free pictures and CD quality sound. For the technophile, there are about 20 megabits per second of information per broadcast channel. HDTV has many viewer benefits.

Benefit: Aspect Ratio
Most televisions today are manufactured in a 4 by 3 aspect ratio, which means the screen is 4 units wide by 3 units high. But theatrically released movies are usually in a much wider aspect, taking advantage of the human field of vision (which is wider across horizontally). HDTV signals are sent in a 16 by 9 aspect ratio, mimicking the wide scope of movies. HDTV's aspect ratio makes for a more immersive and intense viewing experience.

Benefit: Picture Resolution
Resolution is a measure of picture sharpness. Current analog television contains about 480 active scanning lines resulting in a picture resolution of about 330 lines of resolution. By comparison today's VHS VCR's have about 240 lines of resolution which is why VHS recordings don't look as sharp as the original picture. DVD's offer higher resolution typically on the order of 400-480 lines of resolution. (Note the number of scanning lines does not equal resolution. For example, both the VHS and DVD formats have 480 active scanning lines but have different resolutions.) HDTV offers resolution that is at least twice that of analog television. You can expect razor sharp images from HDTV.

I have heard that there are two HDTV formats — 720p and 1080i. Is there a difference between these formats and can my television receive both these formats?
Regardless of the HDTV format being broadcast, all new HDTV receivers can receive both formats. New HDTV televisions will convert any received signal to a format that is compatible with your new display. The 720p format uses

progressive scanning, which is just like your computer monitor. Progressive scan offers crystal clear images that virtually eliminates those scanning lines that are visible on most large screen televisions. ABC broadcasts all of its programming using the 720p format except in Dallas, where the ABC station broadcasts in 1080i. Many new flat panel displays use progressive scan.

The 1080i format uses interlace scanning just like today's analog televisions. Scanning lines are less visible on big screens due to the number of lines. Most older projection HDTV's use 1080i.

Benefit: Digital Sound

Just as your CDs sound better than your old audiocassette tapes, HDTV's digital audio signal sounds better than standard television's analog sound. Also, some HDTV programs include Dolby Digital 5.1 surround sound. Properly decoded, each audio track can be sent to a different speaker, creating a three-dimensional sound field in your living room. Many of ABC's prime time programs contain Dolby Digital surround sound for your listening pleasure.

What do I need to receive HDTV?

In most areas, HDTV is only available as an over-the-air broadcast signal. This requires the use, in most cases, of an outdoor antenna pointed in the direction of the broadcaster's tower. You will also need a new HDTV receiver that can decode the digital signals. HDTV channels are typically different than your cable or over-the-air channel.

Please see the attached list of those cities where ABC HDTV programs are available.

Is HDTV replacing standard television?

Not immediately. ABC and other broadcasters will continue to offer programs in the standard format for at least the next several years. However, the federal government hopes broadcasters and consumers adopt the new format by 2006. Thus, the next few years will be a transition, as television networks add more digital broadcasting to their offerings.

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Dear Yahoo!:

What is HDTV?

TV Techie

Dear Techie:

We knew that HDTV was an acronym for high-definition television and that HDTV sets seem a bit expensive. Luckily, HowStuffWorks.com offers a detailed explanation of **HDTV** and how it works. The site also includes general information on television and examines digital TV, the basis for HDTV.

A conventional, analog TV uses a cathode ray tube to deliver images to you, which limits the quality of the image. The screen resolution of an analog TV is about 512x400 pixels. HDTV uses a digital display, like your computer monitor, and the screen resolution is at least 1280x720 pixels, which is comparable to a high-end computer display. A higher screen resolution means a crisper, clearer picture.

In addition to dramatically improved picture quality, HDTV also offers a wider format. This makes an HDTV image more like a movie-screen image. The width-to-height ratio -- called the *aspect ratio* -- of HDTV is 16:9. Analog TV has an aspect ratio of only 4:3.

The difference in aspect ratio is most noticeable when watching theatrical movies on TV. For analog TV, the movie must be cut down in a process called "pan and scan," in which a part of every scene is deleted to fit the lower aspect ratio. The only way to see the entire movie scene on an analog TV is to "letterbox" the movie. In letterboxing, the full movie is shown in the middle of the screen with black bars at the top and bottom. HDTV eliminates letterboxing and allows you to see the complete movie on the whole TV screen.

The Federal Communications Commission (FCC) agrees with TV networks and manufacturers that digital television, including HDTV, should be the new standard for broadcasting. As of May 1999, the FCC requires the top TV networks to broadcast a digital signal in the 10 biggest markets, which represent 30 percent of TV households in the U.S. The networks plan to expand digital coverage and phase out analog TV broadcasts entirely by the end of 2006.

The HDTV Galaxy FAQ addresses a major question raised by HDTV -- why do we still have analog TVs? TV stations and media production companies have to upgrade equipment in order to produce HDTV programming, a slow and costly process. For this reason, the FCC created a transition plan slated to end in 2006. Also, HDTV sets are

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currently more expensive than analog TVs. It is expected that when consumer demand for the sets increases, production will also increase. And, and as was the case with color TVs, VCRs, and even DVD players, the prices will eventually fall.

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How HDTV Works

by Gary Brown

HDTV has been getting media attention for several years now, and if you go to an electronics store you can see a fairly good selection of HDTV sets today.

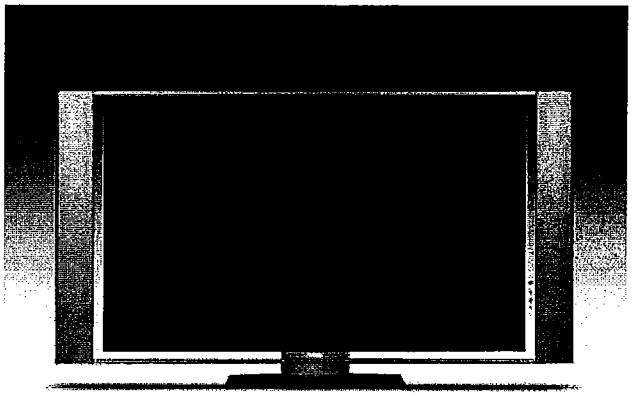


Photo courtesy Sony Electronics
Sony Wega 42" XBR Plasma TV with built-in HDTV tuner

If you have ever looked at one of these sets, you know that the image they display is sharper and wider -- it is more like a movie screen than it is a TV set!

HDTV has lifelike pictures and digital sound. The higher resolution produces clarity like you have never seen from a picture tube. Films retain their original width, enhancing your home theater experience. Imagine seeing *more* of a football field or a scenic panorama!

In this article, we'll take a close look at HDTV and what you get with HDTV. We'll also explain the equipment needed and talk about what you should consider when purchasing a set. There's also a huge link section so that you can learn more!

Related Books
- "Guide to HDTV Systems," by Conrad Persson
- "The Guide To Digital Television," by Michael Silbergleid, Mark J. Pescatore

What Is HDTV?

If you have read How Television Works, then you know all about what is now called **analog TV**. In analog TV, a 6 MHz analog signal carries intensity and color information for each **scan line** of the picture. An analog TV signal in the U.S. has 525 scan lines for the image, and each image is refreshed every 30th of a second (half of the scan lines are painted every sixtieth of a second in what is called an **interlaced** display). The horizontal resolution is something like 500 dots for a color set.

This level of resolution was amazing 50 years ago, but today it is rather passe. The lowest resolution computer monitor that anyone uses today has 640x480 pixels, and most people use a resolution like 800x600 or 1024x768. We have grown comfortable with the great clarity and solidity of a computer display, and analog TV technology pales by comparison.

Many of the new satellite systems, as well as DVDs, use a digital encoding scheme that provides a much clearer picture. In these systems, the digital information is converted to the analog format to display it on your analog TV. The image looks great compared to a VHS tape, but it would be twice as good if the conversion to analog didn't happen.

There is now a big push underway to convert all TV sets from analog to digital, so that digital signals

drive your TV set directly.

When you read and hear people talking about **digital television** (DTV), what they are talking about is the transmission of pure digital television signals, along with the reception and display of those signals on a digital TV set. The digital signals might be broadcast over the air or transmitted by a cable or satellite system to your home. In your home, a decoder receives the signal and uses it, in digital form, to directly drive your digital TV set.

There is a class of digital television that is getting a lot of press right now. It is called **high-definition television**, or HDTV. HDTV is high-resolution digital television (DTV) combined with Dolby Digital surround sound (AC-3). HDTV is the highest DTV resolution in the new set of standards. This combination creates a stunning image with stunning sound. **HDTV** requires new production and transmission equipment at the **HDTV stations**, as well as new equipment for reception by the consumer. The higher resolution picture is the main selling point for HDTV. Imagine 720 or 1080 lines of resolution compared to the 525 lines people are used to in the United States (or the 625 lines in Europe) -- it's a huge difference!

Of the 18 DTV formats, six are HDTV formats, five of which are based on progressive scanning and one on interlaced scanning. Of the remaining formats, eight are SDTV (four wide-screen formats with 16:9 aspect ratios, and four conventional formats with 4:3 aspect ratios), and the remaining four are video graphics array (VGA) formats. Stations are free to choose which formats to broadcast.

The formats used in HDTV are:

- **720p** - 1280x720 pixels progressive
- **1080i** - 1920x1080 pixels interlaced
- **1080p** - 1920x1080 pixels progressive

"Interlaced" or "progressive" refers to the **scanning system**. In an **interlaced** format, the screen shows every odd line at one scan of the screen, and then follows that up with the even lines in a second scan. Since there are 30 frames shown per second, the screen shows one half of the frame every sixtieth of a second. For smaller screens, this is less noticeable. As screens get larger, the problem with interlacing is **flicker**.

Progressive scanning shows the whole picture, every line in one showing, every sixtieth of a second. This provides for a much smoother picture, but uses slightly more bandwidth.

MPEG-2

Broadcasters are having to squeeze the increased picture detail and higher quality surround sound into the same 6-megahertz (MHz) bandwidth used by analog television (see How Television Works for details on bandwidth). Compression software, very similar to what is used in personal computing, allows this to happen.

Digital TV relies on a compression and encoding scheme known as MPEG-2 to fit its stunning images into a reasonable amount of bandwidth. In each image, the MPEG-2 software records just enough of the picture without making it look like something is missing. In subsequent frames, the software only records changes to the image and leaves the rest of the image as-is from the previous frame. MPEG-2 reduces the amount of data by about **55 to 1**.

MPEG-2 already is the industry standard for DVD videos and some of the satellite TV broadcast systems. Compression reduces image quality from what is seen by the digital camera at the studio. However, MPEG-2 is very good at throwing away image detail that the human eye ignores anyway. The quality of the image is very good, and significantly better than traditional analog TV.

The use of MPEG-2 permits an HDTV receiver to interact with computer multimedia applications directly. For example, an HDTV show could be recorded on a multimedia computer, and CD-ROM applications could be played on HDTV systems. A digital TV decodes the MPEG-2 signal and displays it just as a computer monitor does, giving it high resolution and stability.

HDTV Stations

There are HDTV stations "on the air" in many large cities. The first HDTV station was WRAL-HD in Raleigh, NC. The Federal Communications Commission (FCC) has mandated that all stations be capable of broadcasting HDTV by 2006. The timeline of HDTV coverage gives you an idea of what will be available in your area, and when. Click here to learn what's on HDTV today.

The FCC mandate affects broadcasters, cable companies and consumers in significant ways:

- Consumers have to buy new equipment, either a set-top box (to convert digital signals to analog signals) or a whole new TV set.
- Broadcasters have to spend a considerable amount of money to switch to HDTV. They have to buy new cameras, new titling and editing equipment, new tape machines, new rigs for their news vans -- its a big investment.

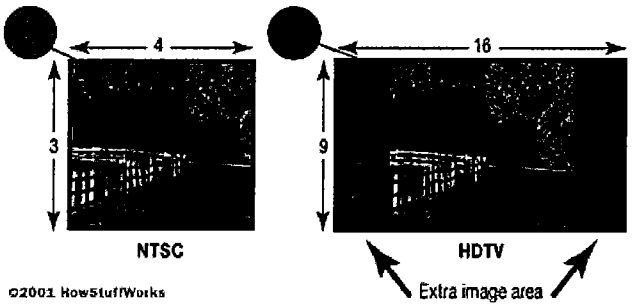
- Cable operators have to convert all of their equipment and all of their set-top boxes.
- Communities need to agree to have new towers built for broadcast channels.

The station decides which DTV format it will transmit. For example, **cable operators** may push for 720p so they can fit more HDTV channels onto the cable. A clear pattern has yet to emerge in the industry.

How is HDTV Different?

The usual National Television Standards Committee (**NTSC**) analog TV screen in the U.S. has 525 scan lines, with 480 actually visible. The usual TV has an effective picture resolution of about 210,000 pixels. In the highest resolution digital TV formats, each picture contains about 2 million pixels. This means about **10 times more picture detail** on the HDTV screen!

DTV may be in either 4:3 or 16:9 format, as shown in the following figure:



The typical TV show uses 35-mm film (or is recorded direct-to-video using NTSC equipment). In the case of film, the broadcaster converts it to an analog TV signal for broadcasting. Standard 35-mm film has an aspect ratio of 1.37:1, meaning it is 1.37 times as wide is it high. A conventional TV screen has a 4:3 (1.33:1) aspect ratio, so the conversion is easy.

To deal with HDTV's new standards, broadcasters will need to get all new equipment, such as cameras, remote broadcast units, control rooms, cables, and sound equipment. This is because digital TV has:

- Wider images
- Much more detailed pictures
- 5.1 channel CD-quality Dolby Digital (AC-3) surround sound
- The ability to send data directly to a screen or to a PC as a download (The actual HDTV transmission is based on a 19.3-Mbps digital data stream.)

The **aspect ratio** (width to height) of digital TV is 16:9 (1.78:1), which is closer to the ratios used in theatrical movies, typically 1.85:1 or 2.35:1. Currently broadcasters must either **pan and scan** the image (crop the full picture of the film down to 4:3, eliminating part of every scene in the process) or **letterbox** it (present the full picture only on the middle part of the screen, with black bars above and below it). With a 16:9 screen, panning and scanning a theatrical movie doesn't remove so much from the original picture and letterboxing doesn't block out so much of your screen. See How Video Formatting Works for more on aspect ratio.

What Do I Need to Buy?

If you live in an area that has active **HDTV stations** broadcasting these shows, then you can buy an HDTV set and enjoy the benefits of HDTV.

Photo courtesy Sony Electronics

Sony's SAT-HD300 set-top box receives HDTV broadcasts as well as HD satellite programming.

Currently, the FCC rules state the start-up of digital broadcasts and phase-out of analog broadcasts in **2006**. Right now, there aren't that many stations broadcasting. As we get closer to 2006, however, your current analog television set will either have to be replaced or you will need to buy some sort of set-top box for converting the digital signal.

To really take advantage of HDTV today, front or rear projection HDTV sets or plasma sets are recommended.

Today's HDTV sets come in several forms. See How Home Theater Works for a full description of what's available in the HDTV realm.

Be sure any television receiver you purchase has input jacks that match the connectors on the VCR, cable box, DVD player and video game console you currently own. For many years, you will have to straddle the digital/analog fence, using, for example, an analog VCR on your digital TV. At the moment, there are no "standards" for what connections will appear on the back of an HDTV set. Therefore you should look for composite, S-video and component video as a minimum set of analog jacks so you can use your existing analog equipment with the new set.

Many early purchasers will have to "go back" to a traditional outside **UHF television antenna** to receive the over-the-air (OTA) HDTV signal. The HDTV transmission system is an eight-level vestigial sideband (VSB) technique that uses UHF channels. Your antenna rotor setting for reception of HDTV signals will be easy to adjust. You either have a picture or you do not -- there cannot be a snowy image with digital technology. There also will not be any "fringe area" reception.

The least expensive way to see HDTV shows right now is to buy an **HDTV converter** for your current analog TV. However, the HDTV shows you see will look no better than DVD on your analog TV -- you will get none of the resolution and format benefits of a real HDTV set.

HDTV conversion will be a process that unfolds over several years. For example, major networks still have to agree on what resolutions they will use. There is no FCC mandate on resolutions for the networks to follow. We are witnessing a merging of three huge industries: personal computers, entertainment, and consumer electronics. Many companies have turf to protect, and a lot of money will be spent on the conversion. That means that the process will be slow and sometimes uncomfortable. However, the ultimate destination is a significant advance -- remarkably better pictures and sound for both your TV and your computer!

Lots More Information

Related HowStuffWorks Articles

- How Digital Television Works
- How Satellite Television Works
- How Cable Television Works
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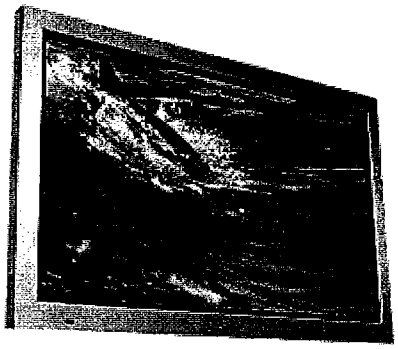
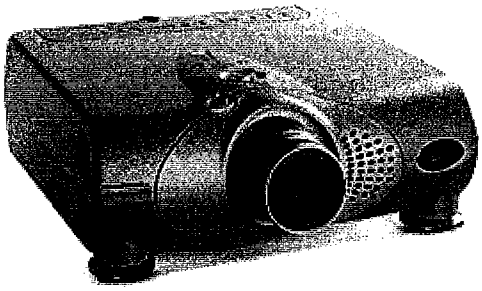
What is DTV?





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WHAT IS DTV?

DTV is an acronym for "Digital TV." It is digital television in its best form. DTV can transmit more than six times the amount of information as the old analog systems, making for better sound and picture quality. Current television sets are made up of 525 lines that are scanned horizontally as compared to DTV which has 1,080 lines. Because DTV has more than double the amount of lines as the older systems, it has more than 2 million pixels. The older analog systems contain only about 300,000 pixels (pixels are the small dots that create a clearer and more detailed picture.) DTV will provide viewers with over 600 channels.

Another quality of DTV is that the screen will be much wider than the older systems. DTV was introduced into the United States in 1998. In 1996, the FCC approved the Digital TV standard for the U.S, which offers a variety of higher quality, all digital signals for TV transmission. DTV is not to be confused with DTV. The two are similar, but DTV is pretty much just a more generic form of DTV. This technology was first used by the Japanese where by 1995, over 150,000 households were using DTV. DTV stands for High Defintion Television.

DTV accounts for six of the 18 video formats established as part of the standards for digital television set by the Advanced Television Standards Committee or the ATSC. Of the 18 formats, these are the highest resolution formats. All six formats feature a 16:9 aspect ratio and acommodate frame rates of 24, 30 and 60 frames per second.

Marantz believes that DTV is the future of television viewing. The hallmark of a true DTV is the rectangular "Wide" screen and the high resolution of display. From the consumer's perspective, High Definition translates to better visual and acoustic enjoyment to TV viewing. Wide screen is defined as 16:9 ratio of width to height. An analog TV has a 4:3 ratio.

The reason that Marantz is exclusively marketing DTV is because of the inevitable upgrade from today's analog TVs. Marantz believes that the future format of broadcasting will be in High Definition and Digital, therefore analog TV signal will be phased out. As Marantz is a

leader in technilogical innovation, it is only logical that we proceed with the DTV format with an eye on the future instead of the technology from the past.

DTV IS CLEARLY BETTER TECHNOLOGY.

DTV is the technology of the digital age while Analog is a primitive technology. The features of DTV is what the technology implies, DTV gives a viewer better screen resolution. The obvious feature of a true DTV is the physical wide screen. Like your computer monitor, a DTV screen is measured in dot pitch. A DTV screen has more vertical and horizontal lines than an analog TV, giving it a much finer and crisper display. The standard is 720 (progressive) or 1080 (interlace) horizontal line of resolution.

What do **Progressive** and **Interlaced** mean? With Interlaced scanning, the lines of a frame are displayed in two passes - half in each pass. With Progressive scanning, all of the lines of a frame are displayed in one pass. In other words, 60 scans per second in Interlaced scan mode equals 30 frames per second while 60 scans per second in progressive scan mode equals 60 frames per second.

Interlaced Scan: On older TVs a picture frame is scanned first with the odd line numbers and then it goes back to fill in the even numbered lines. This reduces the bandwidth required to send a picture and was popular with broadcast video. It does result in a a bit of flicker on the screen.

Progressive Scan: With the method a whole picture frame is painted at once. It requires the higher bandwidth afforded by DTV, Tivo like devices and DVDs. It results ia a much clearer, flicker free picture. This is most notable at the edges of the pictureJust think of it as the SVGA display as compare to the "EGA" display of the early computer monitors. Because the screen format is wide, it can display a wider picture similar to that of a movie theater's screen. Analog TV can only display "cropped" movies. In addition, DTV broadcasts will be in the Dolby surround digital format that further enhances the TV viewing experiences.

The reason there are still analog tv sets is because of the cost of producing DTV programming not the cost of the DTV sets. Media production companies have been reluctant to embrace this new technology due to the equipment upgrading costs but this will change dramatically in the next five years.

There are broadcast standards for the DTV format, but they are regional. Just like analog broadcasts, different regions of the world have different broadcasting formats. There is no worldwide industry standard for digital broadcasting format either. From Marantz's point of view our DTV receive and display all 18 formats.

THE DIFFERENCE BETWEEN DTV AND DTV

Simply put, is that DTV is not the ultimate but a temporary standard necessary to ease the transition from analog to DTV.

DTV refers to sets that are able to:

1) receive digital signal

2) display in high definition,

3) without any additional equipment. DTV is Digital TV, DTV can receive digital signal but can only display 480i screen resolution. Most DTV sets are not wide screens. DTV-ready is a strip down version of the real DTV. DTV-ready TVs are either standard or wide screens but do not have the built-in digital decoder to display high resolution.

DTV PROGRAMMING HAS STARTED

As you read this today. Every major network along with several cable channels broadcast their primetime and special event shows and movies in DTV.

The development of an DTV standard has been underway in the US since 1987. The FCC determined that it wanted DTV and accepted proposals for DTV. Initially all of the proposals were for analog transmissions until approximately 1990 when the FCC had four digital proposals which it could not decide upon. Instead of selecting one of these, they suggested the idea of a grand alliance of companies and had all of these work together to come up with one standard for DTV.

DTV enhances the quality of the picture on your screen and the quality of the sound. In the future DTV will allow the connectivity of computers and televisions.

7 FEATURES TO EXPECT FROM DTV ARE:

1. High Definition

With a screen pixel ratios from 1024 x 768 DTV and higher it is far superior than analog television.

2. Larger picture

In addition to the viewing distance function, a new aspect ratio (height of the picture to the width) is added. The width is changed from the traditional 4:3 ratio to 16:9. All this means to say the proscribed viewing distance is much closer to the screen (e.g. if the screen is 1 foot tall the proscribed viewing distance is 3 feet from the screen). The precise reason for widening the screen is to provide a 30 degree field of vision for the viewer. This occurs when viewing exactly at the proscribed distance. A 30 degree field of vision is dramatically more "real" for the viewer compared to a ten degree field customarily with NTSC (standard) at the 8 to 10 picture heights distance. The key to understanding the difference between DTV and standard TV is that clarity is a matter only of distance. Distance relates directly to how great your field of vision is. A 30 degree field of vision for the viewer is the goal of DTV.

3. More colors

DTV images carry five times the color information NTSC carries. The precision of the new images is quite revolutionary. They are presented in their varying intensities of reds, violets, greens, and blues with all shades in-between. This is like a Kodak picture that moves on the screen. All well made NTSC TV sets with a strong well transmitted signal will look clear at some distance, usually about 8 to 10 times the height of the picture. Due to the absolute limits

of NTSC the image is never clearer than what 525 scanning lines interlaced can produce. There are also numerous inherently troublesome artifacts which appear until at least 8 times the picture height. This means that with an DTV set and an NTSC set with the same picture height -using the 1 foot height example- the distance should be 3 feet for the DTV and 8 feet for the NTSC set. The field of vision is 30 degrees at that distance with the DTV, and something less than 10 degrees with the NTSC set.

4. Wider Screen

The first thing you notice about High Definition Television is the size of the screen. This simulates an actual movie theater screen. Watching films, "adapted to fit your TV," will soon be a thing of the past.

5. Multi-channel digital CD quality sound

You will hear a more natural tonal balance. Many motion pictures reproduced through typical home audio systems will sound unnaturally bright. The dialogue will be more intelligible. In 6.1 channel mixes, all 6 main channels can be operating at once. With dense sound mixes, action effects can seriously mask subtle dialogue. In the Multi-Channel Audio System, you will hear dialogue more distinctly, even in sequences with loud or complex sound effects.
You will experience a more uniform sound envelope. The front and surround soundfields will merge, seamlessly putting you into the motion picture. Sound localization will be more accurate and focused. You will notice that sound closely follows the action on the screen.
You will experience all of the dynamic range and frequency response of a motion picture soundtrack without distortion or other artifacts. The system will effortlessly reproduce the bottom two octaves of bass with clarity and precision.

6. New body types.

We've all seen the commercials for flat television. Computer screens, televisions screens and any type of displays are now experiencing a renaissance in new design. Wit the flexibility of flat backed televisions companies can now create new products that are more than a piece of equipment.

7. New content.

With the advent of digital television comes digital programming. With digital programming comes the merging of technological content venues. Translated, that means that digital computers, cameras, VCRs, satellite programming, networks both public and private will begin to offer programming. Digital television is going to change a lot of things.This corresponds with the 9 of the 18 proposed DTV formats below that DTV support.

#	HORIZ. LINES	VERT LINES	ASPECT RATIO	FRAMES PER SEC	SCAN MODE
18	1920	1080	16:9	30	Interlaced
17	1920	1080	16:9	30	Progressive

16	1920	1080	16:9	24	Progressive
15	1280	720	16:9	60	Progressive
14	1280	720	16:9	30	Progressive
13	1280	720	16:9	24	Progressive
12	704	480	16:9	30	Interlaced
11	704	480	16:9	60	Progressive
10	704	480	16:9	30	Progressive
9	704	480	16:9	24	Progressive
8	704	480	4:3	30	Interlaced
7	704	480	4:3	60	Progressive
6	704	480	4:3	30	Progressive
5	704	480	4:3	24	Progressive
4	640	480	4:3	30	Interlaced
3	640	480	4:3	60	Progressive
2	640	480	4:3	30	Progressive
1	640	480	4:3	24	Progressive

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How HDTV Works

by Gary Brown

What Is HDTV?

If you have read How Television Works, then you know all about what is now called **analog TV**. In analog TV, a 6 MHz analog signal carries intensity and color information for each **scan line** of the picture. An analog TV signal in the U.S. has 525 scan lines for the image, and each image is refreshed every 30th of a second (half of the scan lines are painted every sixtieth of a second in what is called an **interlaced** display). The horizontal resolution is something like 500 dots for a color set.

This level of resolution was amazing 50 years ago, but today it is rather passe. The lowest resolution computer monitor that anyone uses today has 640x480 pixels, and most people use a resolution like 800x600 or 1024x768. We have grown comfortable with the great clarity and solidity of a computer display, and analog TV technology pales by comparison.

Many of the new satellite systems, as well as DVDs, use a digital encoding scheme that provides a much clearer picture. In these systems, the digital information is converted to the analog format to display it on your analog TV. The image looks great compared to a VHS tape, but it would be twice as good if the conversion to analog didn't happen.

There is now a big push underway to convert all TV sets from analog to digital, so that digital signals drive your TV set directly.

When you read and hear people talking about **digital television** (DTV), what they are talking about is the transmission of pure digital television signals, along with the reception and display of those signals on a digital TV set. The digital signals might be broadcast over the air or transmitted by a cable or satellite system to your home. In your home, a decoder receives the signal and uses it, in digital form, to directly drive your digital TV set.

There is a class of digital television that is getting a lot of press right now. It is called **high-definition television**, or HDTV. HDTV is high-resolution digital television (DTV) combined with Dolby Digital surround sound (AC-3). HDTV is the highest DTV resolution in the new set of standards. This combination creates a

stunning image with stunning sound. **HDTV** requires new production and transmission equipment at the **HDTV stations**, as well as new equipment for reception by the consumer. The higher resolution picture is the main selling point for HDTV. Imagine 720 or 1080 lines of resolution compared to the 525 lines people are used to in the United States (or the 625 lines in Europe) -- it's a huge difference!

Of the 18 DTV formats, six are HDTV formats—five of which are based on progressive scanning and one on interlaced scanning. Of the remaining formats, eight are SDTV (four wide-screen formats with 16:9 aspect ratios, and four conventional formats with 4:3 aspect ratios), and the remaining four are video graphics array (VGA) formats. Stations are free to choose which formats to broadcast.

The formats used in HDTV are:

- **720p** - 1280x720 pixels progressive
- **1080i** - 1920x1080 pixels interlaced

"Interlaced" or "progressive" refers to the **scanning system**. In an **interlaced** format, the screen shows every odd line at one scan of the screen, and then follows that up with the even lines in a second scan. Since there are 30 frames shown per second, the screen shows one half of the frame every sixtieth of a second. For smaller screens, this is less noticeable. As screens get larger, the problem with interlacing is **flicker**.

Progressive scanning shows the whole picture, every line in one showing, every sixtieth of a second. This provides for a much smoother picture, but uses slightly more bandwidth.

MPEG-2

Broadcasters are having to squeeze the increased picture detail and higher quality surround sound into the same 6-megahertz (MHz) bandwidth used by analog television (see How Television Works for details on bandwidth). Compression software, very similar to what is used in personal computing, allows this to happen.

Digital TV relies on a compression and encoding scheme known as MPEG-2 to fit its stunning images into a reasonable amount of bandwidth. In each image, the MPEG-2 software records just enough of the picture without making it look like something is missing. In subsequent frames, the software only records changes to the image and leaves the rest of the image as-is from the previous frame. MPEG-2 reduces the amount of data by about **55 to 1**.

MPEG-2 already is the industry standard for DVD videos and some of the satellite TV broadcast systems. Compression reduces image quality from what is seen by the digital camera at the studio. However, MPEG-2 is very good at throwing away image detail that the human eye ignores anyway. The quality of the image is very good, and significantly better than traditional analog TV.

The use of MPEG-2 permits an HDTV receiver to interact with computer multimedia applications directly. For example, an HDTV show could be recorded on a multimedia computer, and CD-ROM applications could be played on HDTV systems. A digital TV decodes the MPEG-2 signal and displays it just as a computer monitor does, giving it high resolution and stability.

HDTV Stations

There are HDTV stations "on the air" in many large cities. The first HDTV station was WRAL-HD in Raleigh, NC. The Federal Communications Commission (FCC) has mandated that all stations be capable of broadcasting HDTV by 2006. The timeline of HDTV coverage gives you an idea of what will be available in your area, and when. Click here to learn what's on HDTV today.

The FCC mandate affects broadcasters, cable companies and consumers in significant ways:

- Consumers have to buy new equipment, either a set-top box (to convert digital signals to analog signals) or a whole new TV set.
- Broadcasters have to spend a considerable amount of money to switch to HDTV. They have to buy new cameras, new titling and editing equipment, new tape machines, new rigs for their news vans -- its a big investment.
- Cable operators have to convert all of their equipment and all of their set-top boxes.
- Communities need to agree to have new towers built for broadcast channels.

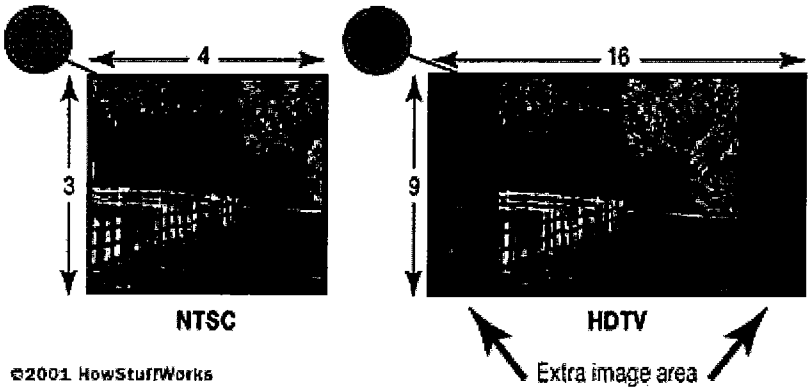
The station decides which DTV format it will transmit. For example, **cable operators** may push for 720p so they can fit more HDTV channels onto the cable. A clear pattern has yet to emerge in the industry.

How is HDTV Different?

The usual National Television Standards Committee (**NTSC**) analog TV screen in the U.S. has 525 scan lines, with 480 actually visible. The usual TV has an effective picture resolution of about 210,000 pixels. In the highest resolution digital TV formats, each picture contains about 2 million pixels. This means about

10 times more picture detail on the HDTV screen!

DTV may be in either 4:3 or 16:9 format, as shown in the following figure:



The typical TV show uses 35-mm film (or is recorded direct-to-video using NTSC equipment). In the case of film, the broadcaster converts it to an analog TV signal for broadcasting. Standard 35-mm film has an aspect ratio of 1.37:1, meaning it is 1.37 times as wide is it high. A conventional TV screen has a 4:3 (1.33:1) aspect ratio, so the conversion is easy.

To deal with HDTV's new standards, broadcasters will need to get all new equipment, such as cameras, remote broadcast units, control rooms, cables, and sound equipment. This is because digital TV has:

- Wider images
- Much more detailed pictures
- 5.1 channel CD-quality Dolby Digital (AC-3) surround sound
- The ability to send data directly to a screen or to a PC as a download (The actual HDTV transmission is based on a 19.3-Mbps digital data stream.)

The **aspect ratio** (width to height) of digital TV is 16:9 (1.78:1), which is closer to the ratios used in theatrical movies, typically 1.85:1 or 2.35:1. Currently broadcasters must either **pan and scan** the image (crop the full picture of the film down to 4:3, eliminating part of every scene in the process) or **letterbox** it (present the full picture only on the middle part of the screen, with black bars above and below it). With a 16:9 screen, panning and scanning a theatrical movie doesn't remove so much from the original picture and letterboxing doesn't block out so much of your screen. See How Video Formatting Works for more on aspect ratio.

What Do I Need to Buy?

If you live in an area that has active **HDTV stations** broadcasting, then you can buy an HDTV set and enjoy the benefits of HDTV.

Currently, the FCC rules state the start-up of digital broadcasts and phase-out of analog broadcasts in **2006**. Right now, there aren't that many stations broadcasting. As we get closer to 2006, however, your current analog television set will either have to be replaced or you will need to buy some sort of set-top box for converting the digital signal.

To really take advantage of HDTV today, front or rear plasma sets are recommended.

Today's HDTV sets come in two forms. **HD-ready** sets have the HDTV receiver/decoder built in, while **HD-capable** sets require the addition of an external receiver/decoder to receive digital broadcasts. In an HD-capable set, the TV is essentially a monitor. You buy the receiver separately.

Be sure any television receiver you purchase has input jacks that match the connectors on the VCR, cable box, DVD player and video game console you currently own. For many years, you will have to straddle the digital/analog fence, using, for example, an analog VCR on your digital TV. At the moment, there are no "standards" for what connections will appear on the back of an HDTV set. Therefore you should look for composite, S-video and component video as a minimum set of analog jacks so you can use your existing analog equipment with the new set.

Many early purchasers will have to "go back" to a traditional outside **UHF television antenna** to receive the over-the-air (OTA) HDTV signal. The HDTV transmission system is an 8-level vestigial sideband (VSB) technique that uses UHF channels. Your antenna rotor setting for reception of HDTV signals will be easy to adjust. You either have a picture or you do not -- there cannot be a snowy image with digital technology. There also will not be any "fringe area" reception.

The least expensive way to see HDTV shows right now is to buy an **HDTV converter** for your current analog TV. However, the HDTV shows you see will look no better than DVD on your analog TV -- you will get none of the resolution and format benefits of a real HDTV set.

HDTV conversion will be a process that unfolds over several years. For example, major networks still have to agree on what resolutions they will use. There is no FCC mandate on resolutions for the networks to follow. We are witnessing a merging of three huge industries: personal computers, entertainment, and consumer electronics. Many companies have turf to protect, and a lot of money

will be spent on the conversion. That means that the process will be slow and sometimes uncomfortable. However, the ultimate destination is a significant advance -- remarkably better pictures and sound for both your TV and your computer!

ADVANCED EXPLANATION

HDTV Television - An Introduction

EE 498

Professor Kelin J. Kuhn

Two lectures of material

I. The movement toward HDTV

The original impetus for HDTV came from wide-screen movies. Soon after wide-screen was introduced, movie producers discovered that individuals seated in the first few rows enjoyed a level of participation in the action not possible with conventional movies. Evidently, having the screen occupy a great field of view (especially peripherally) significantly increases the sense of "being there".

Early in the 1980s, movie producers were offered a high-definition television system developed by Sony and NHK in the late 70s. This system (called NHK Hi-vision) and its variants are capable of producing images having essentially the same detail as 35 mm film[1]. With these systems, a scene could be recorded, played and edited immediately, and then transferred to film. As a consequence, many of the intermediate delays in conventional film production were eliminated. The new medium also offered a number of possibilities for special effects not possible in conventional film production.

Following the introduction of HDTV to the film industry, interest began to build in developing an HDTV system for commercial broadcasting. Such a system would have roughly double the number of vertical lines and horizontal lines when compared to conventional systems.

Now, the most significant problem faced with HDTV is exactly the same problem

faced with color TV in 1954. There are approximately 600 million television sets in the world and approximately 70% of them are color TVs. An important and critical consideration is whether the new HDTV standard should be ***compatible*** with the existing color TV standards, ***supplant*** the existing standards, or be ***simultaneously*** broadcast with the existing standards (with the understanding that the existing standards would be faded out over time).

There is precedence for both compatibility and simultaneous broadcast. In 1957, the US chose compatibility when developing the color TV standard. Although there were some minor carrier interference problems due to the additional chrominance signal -- to a large extent, both monochrome and color TVs could read the same signal.

As a example of simultaneous broadcast, consider Britain. Monochrome broadcast began in Britain in 1936 with a 405 line standard. In 1967, the 625 line PAL color standard was introduced. The color and monochrome standards then operated in parallel for fifty years. In 1986, when the 405 line service was terminated, so few 405 line monochrome monitors remained that it was seriously considered that Parliament simply purchase 625 line monitors for the remaining 405 line users, as that was considerably cheaper than maintaining the 405 line service. (This amusing idea did not happen however, due to possible political repercussions!)

II. Basic ideas for HDTV

The basic concept behind high-definition television is actually not to increase the definition per unit area ... but rather to increase the percentage of the visual field contained by the image.

The majority of proposed analog and digital HDTV systems are working toward approximately a 100% increase in the number of horizontal and vertical pixels. (Proposals are roughly 1 MB per frame with roughly 1000 lines by 1000 horizontal points). This typically results in a factor of 2-3 improvement in the angle of the vertical and horizontal fields. The majority of HDTV proposals also change the aspect ratio to 16/9 from 4/3 -- making the image more "movie-like".

KSAT.com

What Is HDTV?

Everything You Ever Wanted To Know About HDTV

What is HDTV? How is it different from normal television?

HDTV is high-definition television, a method of digital broadcasting that results in high-quality pictures and Dolby Digital surround sound.

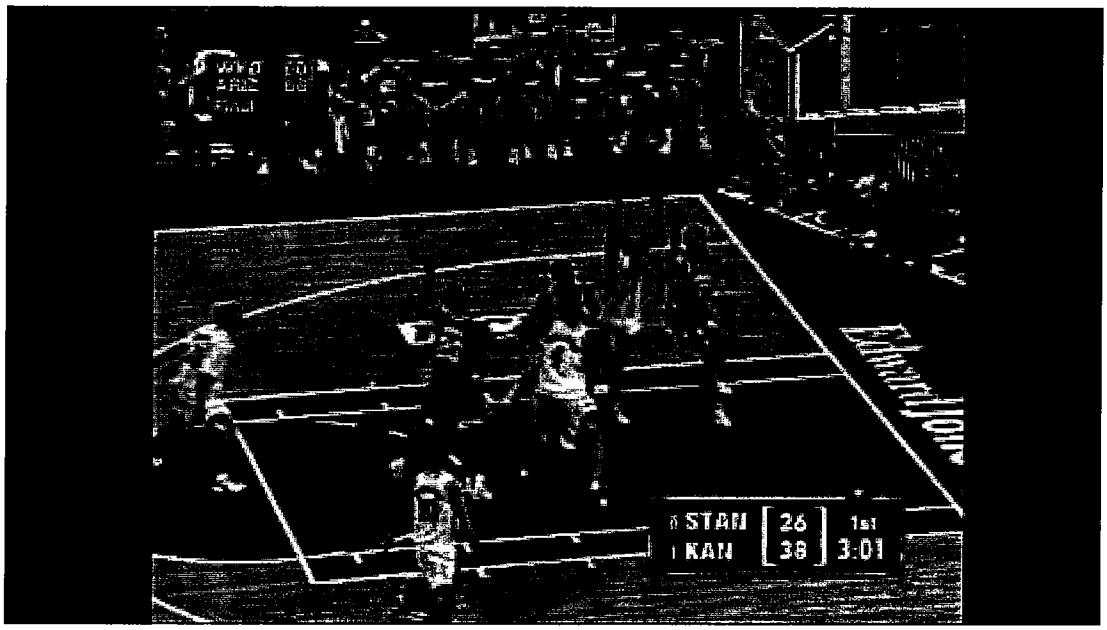
HDTV uses the same amount of bandwidth (6 megahertz) as used in the current analog system, but HDTV can transmit more than six times the information as the analog system. This translates to higher quality in picture and sound.

How Much Better Is The Quality?

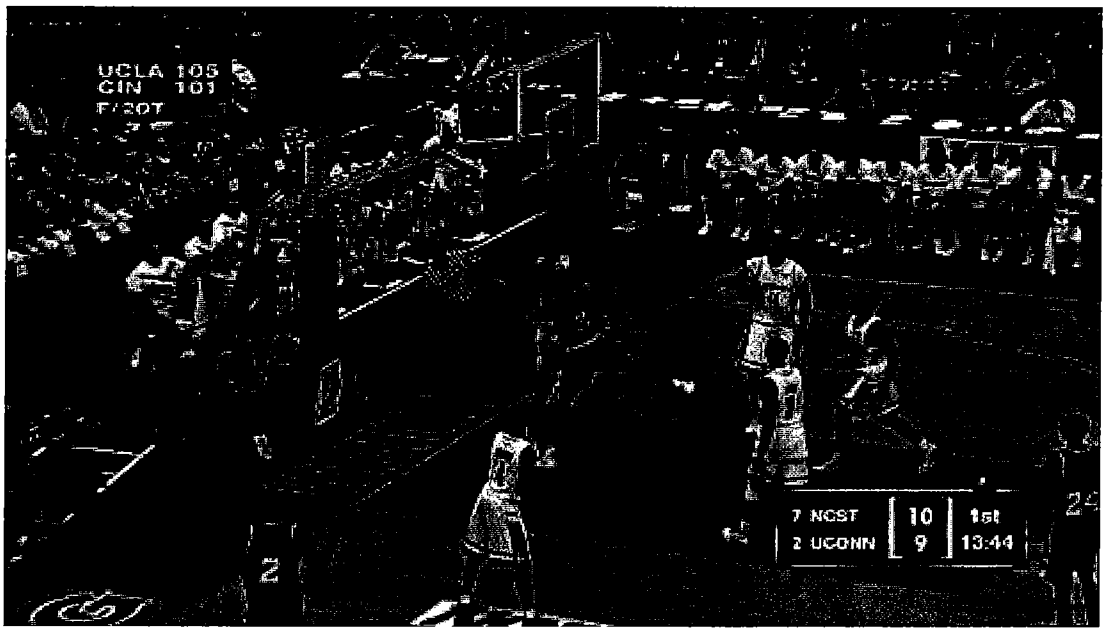
Currently, television pictures are made up of 525 lines that are scanned horizontally. HDTV pictures are created by scanning 1,080 lines. Adding twice the amount of lines multiplies the amount of pixels (the small dots that create the picture).

Current sets have about 300,000 pixels, while the HDTV screen is composed of more than 2 million pixels.

Here is a traditional image resolution:



Here is an HDTV image:



Having more pixels on your screen will also improve the sharpness of your pictures, allowing you to read on your television screen small text commonly found on computers.

HDTV sets have wider, movie-theater like screens that more closely resemble human peripheral vision, making it more natural to watch.

Is The Sound Different?

A WIDER VIEW

Complimenting the lifelike pictures are 5.1 channels of CD-quality digital audio. Current stereo TV sets offer only two channels of audio. HDTV delivers true surround sound: front speakers on the right, center and left, along with two back speakers and a subwoofer.

Are HDTV Signals Broadcast On Special Frequencies?

No. HDTV broadcasts use the same channels as regular analog television. While many DTV stations are now occupying UHF broadcast channels, the plan is to allow many broadcasters to move back to their original VHF or UHF TV channel once the transition to DTV is complete.

You should be able to receive DTV with any standard UHF antenna. The exact style of antenna that you will need for optimal reception may vary depending on your geographic location and distance to the transmission source.

HDTV screens are about one-third wider than existing TV screens. They have similar dimensions to movie screens. HDTV screens closely match the peripheral vision range of the human eye, making it more natural to watch.

HDTV
16:9 ratio

Regular TV
4:3 ratio

Is HDTV Similar To Interactive Television?

With HDTV, broadcasters can now broadcast data via "datacasting." Datacasting opens up the possibility of interactive television, empowering the viewer to make television-viewing an incredible experience.

With More Space, Can You Have More Channels?

We can squeeze in more than one "channel" of television or data into our digital TV channel. In special circumstances, we can

choose to send a channel of high-definition TV, up to two channels of standard-definition TV (SDTV) and a channel of data at the same time.

In severe weather, we can send regular programming over one channel and weather information over the other channels. During sporting events, we can broadcast more than one game at the same time, giving you the choice of which game to watch.

Where Can I Buy An HDTV Set? How Much Do They Cost?

If your TV has progressive-scan inputs for connection to a computer display card or DVD player, you'll be able to see some HDTV signals by adding a set-top box receiver (STB), which will generally yield some but not all of the advanced resolution of HTDV. These cost in the range of $400 to $1,000.

Otherwise, you can buy new HDTV sets at most electronics stores. Just like any cutting-edge electronic equipment, the early receivers are expensive. When HDTV sets came on the market, they cost as much as $8,000. In a short amount of time, prices have dropped to around $2,000, and prices may drop to $1,500 within a year.

What Is The Difference Between An HDTV Set And A Digital-Ready TV Set?

An HDTV set is able to receive all digital formats and display them in super-high resolution on a wider screen than analog TV.

A digital-ready TV set (or HDTV-ready) is designed to receive digital signals with a decoder box. These sets are usually capable of providing higher resolution pictures than analog TV sets, but some sets marked as "digital-ready" are not capable of carrying HD programming.

As with any major purchase, do you homework before buying a set.

How Long Will It Take For The Television World To Switch To The New Digital Technology?

Originally, the Federal Communications Commission set Jan. 1, 2007, as the final date to turn off the existing analog television systems. Congress will inevitably delay that date until more than 85 percent of the people have access to digital television signals.

A deadline recently passed for having 1,300 commercial broadcasters offering a digital signal. The General Accounting Office in Washington reported that three-quarters of the stations that were supposed to be airing digital programs are still lagging.

Will My Current TV Set Be Obsolete?

You will be able to watch digital TV signals on your existing TV set with a set-top digital receiver. However, you will not be able to enjoy the crisp high-definition picture.

What About My VCR, DVD Player And Camcorder? Will I Be Able To Use Them With An HDTV Set?

HDTV sets are "backward compatible," meaning all existing analog equipment (VCRs, DVD players, camcorders, video games, etc.) will work on digital TV sets, but not in high definition. Their video will be displayed in the maximum resolution that each product is capable of.

How HDTV Works

by Gary Brown

HDTV has been getting media attention for several years now, and if you go to an electronics store you can see a fairly good selection of HDTV sets today.

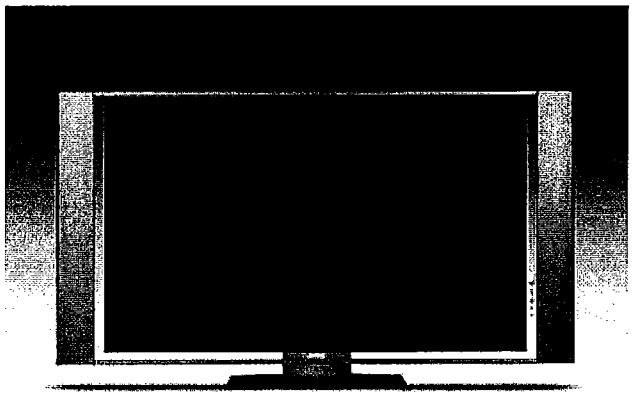


Photo courtesy Sony Electronics
Sony Wega 42" XBR Plasma TV with built-in HDTV tuner

If you have ever looked at one of these sets, you know that the image they display is sharper and wider -- it is more like a movie screen than it is a TV set!

HDTV has lifelike pictures and digital sound. The higher resolution produces clarity like you have never seen from a picture tube. Films retain their original width, enhancing your home theater experience. Imagine seeing *more* of a football field or a scenic panorama!

In this article, we'll take a close look at HDTV and what you get with HDTV. We'll also explain the equipment needed and talk about what you should consider when purchasing a set. There's also a huge link section so that you can learn more!

Related Books
- "Guide to HDTV Systems," by Conrad Persson
- "The Guide To Digital Television," by Michael Silbergleid, Mark J. Pescatore

What Is HDTV?

If you have read How Television Works, then you know all about what is now called **analog TV**. In analog TV, a 6 MHz analog signal carries intensity and color information for each **scan line** of the picture. An analog TV signal in the U.S. has 525 scan lines for the image, and each image is refreshed every 30th of a second (half of the scan lines are painted every sixtieth of a second in what is called an **interlaced** display). The horizontal resolution is something like 500 dots for a color set.

This level of resolution was amazing 50 years ago, but today it is rather passe. The lowest resolution computer monitor that anyone uses today has 640x480 pixels, and most people use a resolution like 800x600 or 1024x768. We have grown comfortable with the great clarity and solidity of a computer display, and analog TV technology pales by comparison.

Many of the new satellite systems, as well as DVDs, use a digital encoding scheme that provides a much clearer picture. In these systems, the digital information is converted to the analog format to display it on your analog TV. The image looks great compared to a VHS tape, but it would be twice as good if the conversion to analog didn't happen.

There is now a big push underway to convert all TV sets from analog to digital, so that digital signals

drive your TV set directly.

When you read and hear people talking about **digital television** (DTV), what they are talking about is the transmission of pure digital television signals, along with the reception and display of those signals on a digital TV set. The digital signals might be broadcast over the air or transmitted by a cable or satellite system to your home. In your home, a decoder receives the signal and uses it, in digital form, to directly drive your digital TV set.

There is a class of digital television that is getting a lot of press right now. It is called **high-definition television**, or HDTV. HDTV is high-resolution digital television (DTV) combined with Dolby Digital surround sound (AC-3). HDTV is the highest DTV resolution in the new set of standards. This combination creates a stunning image with stunning sound. **HDTV** requires new production and transmission equipment at the **HDTV stations**, as well as new equipment for reception by the consumer. The higher resolution picture is the main selling point for HDTV. Imagine 720 or 1080 lines of resolution compared to the 525 lines people are used to in the United States (or the 625 lines in Europe) -- it's a huge difference!

Of the 18 DTV formats, six are HDTV formats, five of which are based on progressive scanning and one on interlaced scanning. Of the remaining formats, eight are SDTV (four wide-screen formats with 16:9 aspect ratios, and four conventional formats with 4:3 aspect ratios), and the remaining four are video graphics array (VGA) formats. Stations are free to choose which formats to broadcast.

The formats used in HDTV are:

- **720p** - 1280x720 pixels progressive
- **1080i** - 1920x1080 pixels interlaced
- **1080p** - 1920x1080 pixels progressive

"Interlaced" or "progressive" refers to the **scanning system**. In an **interlaced** format, the screen shows every odd line at one scan of the screen, and then follows that up with the even lines in a second scan. Since there are 30 frames shown per second, the screen shows one half of the frame every sixtieth of a second. For smaller screens, this is less noticeable. As screens get larger, the problem with interlacing is **flicker**.

Progressive scanning shows the whole picture, every line in one showing, every sixtieth of a second. This provides for a much smoother picture, but uses slightly more bandwidth.

MPEG-2

Broadcasters are having to squeeze the increased picture detail and higher quality surround sound into the same 6-megahertz (MHz) bandwidth used by analog television (see How Television Works for details on bandwidth). Compression software, very similar to what is used in personal computing, allows this to happen.

Digital TV relies on a compression and encoding scheme known as MPEG-2 to fit its stunning images into a reasonable amount of bandwidth. In each image, the MPEG-2 software records just enough of the picture without making it look like something is missing. In subsequent frames, the software only records changes to the image and leaves the rest of the image as-is from the previous frame. MPEG-2 reduces the amount of data by about **55 to 1**.

MPEG-2 already is the industry standard for DVD videos and some of the satellite TV broadcast systems. Compression reduces image quality from what is seen by the digital camera at the studio. However, MPEG-2 is very good at throwing away image detail that the human eye ignores anyway. The quality of the image is very good, and significantly better than traditional analog TV.

The use of MPEG-2 permits an HDTV receiver to interact with computer multimedia applications directly. For example, an HDTV show could be recorded on a multimedia computer, and CD-ROM applications could be played on HDTV systems. A digital TV decodes the MPEG-2 signal and displays it just as a computer monitor does, giving it high resolution and stability.

HDTV Stations

There are HDTV stations "on the air" in many large cities. The first HDTV station was WRAL-HD in Raleigh, NC. The Federal Communications Commission (FCC) has mandated that all stations be capable of broadcasting HDTV by 2006. The timeline of HDTV coverage gives you an idea of what will be available in your area, and when. Click here to learn what's on HDTV today.

The FCC mandate affects broadcasters, cable companies and consumers in significant ways:

- Consumers have to buy new equipment, either a set-top box (to convert digital signals to analog signals) or a whole new TV set.
- Broadcasters have to spend a considerable amount of money to switch to HDTV. They have to buy new cameras, new titling and editing equipment, new tape machines, new rigs for their news vans -- its a big investment.

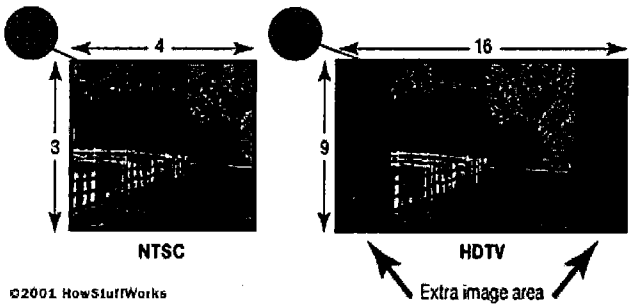
- Cable operators have to convert all of their equipment and all of their set-top boxes.
- Communities need to agree to have new towers built for broadcast channels.

The station decides which DTV format it will transmit. For example, **cable operators** may push for 720p so they can fit more HDTV channels onto the cable. A clear pattern has yet to emerge in the industry.

How is HDTV Different?

The usual National Television Standards Committee (**NTSC**) analog TV screen in the U.S. has 525 scan lines, with 480 actually visible. The usual TV has an effective picture resolution of about 210,000 pixels. In the highest resolution digital TV formats, each picture contains about 2 million pixels. This means about **10 times more picture detail** on the HDTV screen!

DTV may be in either 4:3 or 16:9 format, as shown in the following figure:



The typical TV show uses 35-mm film (or is recorded direct-to-video using NTSC equipment). In the case of film, the broadcaster converts it to an analog TV signal for broadcasting. Standard 35-mm film has an aspect ratio of 1.37:1, meaning it is 1.37 times as wide is it high. A conventional TV screen has a 4:3 (1.33:1) aspect ratio, so the conversion is easy.

To deal with HDTV's new standards, broadcasters will need to get all new equipment, such as cameras, remote broadcast units, control rooms, cables, and sound equipment. This is because digital TV has:

- Wider images
- Much more detailed pictures
- 5.1 channel CD-quality Dolby Digital (AC-3) surround sound
- The ability to send data directly to a screen or to a PC as a download (The actual HDTV transmission is based on a 19.3-Mbps digital data stream.)

The **aspect ratio** (width to height) of digital TV is 16:9 (1.78:1), which is closer to the ratios used in theatrical movies, typically 1.85:1 or 2.35:1. Currently broadcasters must either **pan and scan** the image (crop the full picture of the film down to 4:3, eliminating part of every scene in the process) or **letterbox** it (present the full picture only on the middle part of the screen, with black bars above and below it). With a 16:9 screen, panning and scanning a theatrical movie doesn't remove so much from the original picture and letterboxing doesn't block out so much of your screen. See How Video Formatting Works for more on aspect ratio.

What Do I Need to Buy?

If you live in an area that has active **HDTV stations** broadcasting these shows, then you can buy an HDTV set and enjoy the benefits of HDTV.

Photo courtesy Sony Electronics

Sony's SAT-HD300 set-top box receives HDTV broadcasts as well as HD satellite programming.

Currently, the FCC rules state the start-up of digital broadcasts and phase-out of analog broadcasts in **2006**. Right now, there aren't that many stations broadcasting. As we get closer to 2006, however, your current analog television set will either have to be replaced or you will need to buy some sort of set-top box for converting the digital signal.

To really take advantage of HDTV today, front or rear projection HDTV sets or plasma sets are recommended.

Today's HDTV sets come in several forms. See How Home Theater Works for a full description of what's available in the HDTV realm.

Be sure any television receiver you purchase has input jacks that match the connectors on the VCR, cable box, DVD player and video game console you currently own. For many years, you will have to straddle the digital/analog fence, using, for example, an analog VCR on your digital TV. At the moment, there are no "standards" for what connections will appear on the back of an HDTV set. Therefore you should look for composite, S-video and component video as a minimum set of analog jacks so you can use your existing analog equipment with the new set.

Many early purchasers will have to "go back" to a traditional outside **UHF television antenna** to receive the over-the-air (OTA) HDTV signal. The HDTV transmission system is an eight-level vestigial sideband (VSB) technique that uses UHF channels. Your antenna rotor setting for reception of HDTV signals will be easy to adjust. You either have a picture or you do not -- there cannot be a snowy image with digital technology. There also will not be any "fringe area" reception.

The least expensive way to see HDTV shows right now is to buy an **HDTV converter** for your current analog TV. However, the HDTV shows you see will look no better than DVD on your analog TV -- you will get none of the resolution and format benefits of a real HDTV set.

HDTV conversion will be a process that unfolds over several years. For example, major networks still have to agree on what resolutions they will use. There is no FCC mandate on resolutions for the networks to follow. We are witnessing a merging of three huge industries: personal computers, entertainment, and consumer electronics. Many companies have turf to protect, and a lot of money will be spent on the conversion. That means that the process will be slow and sometimes uncomfortable. However, the ultimate destination is a significant advance -- remarkably better pictures and sound for both your TV and your computer!

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- FCC HDTV Channel Plan
- HDTVGalaxy: news for consumers, program schedules

HDTV Television - An Introduction

EE 498

Professor Kelin J. Kuhn

Two lectures of material

I. The movement toward HDTV

The original impetus for HDTV came from wide-screen movies. Soon after wide-screen was introduced, movie producers discovered that individuals seated in the first few rows enjoyed a level of participation in the action not possible with conventional movies. Evidently, having the screen occupy a great field of view (especially peripherally) significantly increases the sense of "being there".

Early in the 1980s, movie producers were offered a high-definition television system developed by Sony and NHK in the late 70s. This system (called NHK Hi-vision) and its variants are capable of producing images having essentially the same detail as 35 mm film[1]. With these systems, a scene could be recorded, played and edited immediately, and then transferred to film. As a consequence, many of the intermediate delays in conventional film production were eliminated. The new medium also offered a number of possibilities for special effects not possible in conventional film production.

Following the introduction of HDTV to the film industry, interest began to build in developing an HDTV system for commercial broadcasting. Such a system would have roughly double the number of vertical lines and horizontal lines when compared to conventional systems.

Now, the most significant problem faced with HDTV is exactly the same problem faced with color TV in 1954. There are approximately 600 million television sets in the world and approximately 70% of them are color TVs. An important and critical consideration is whether the new HDTV standard should be ***compatible*** with the existing color TV standards, ***supplant*** the existing standards, or be ***simultaneously*** broadcast with the existing standards (with the understanding that the existing standards would be faded out over time).

There is precedence for both compatibility and simultaneous broadcast. In 1957, the US chose compatibility when developing the color TV standard. Although there were some minor carrier interference problems due to the additional chrominance signal -- to a large extent, both monochrome and color TVs could read the same signal.

As a example of simultaneous broadcast, consider Britain. Monochrome broadcast began in Britain in 1936 with a 405 line standard. In 1967, the 625 line PAL color standard was introduced. The color and monochrome standards then operated in parallel for fifty years. In 1986, when the 405 line service was terminated, so few 405 line monochrome monitors remained that it was seriously considered that Parliament simply purchase 625 line monitors for the remaining 405 line users, as that was considerably cheaper than maintaining the 405 line service. (This amusing idea did not happen however, due to possible political repercussions!)

II. Basic ideas for HDTV

The basic concept behind high-definition television is actually not to increase the definition per unit area ... but rather to increase the percentage of the visual field contained by the image.

The majority of proposed analog and digital HDTV systems are working toward approximately a 100% increase in the number of horizontal and vertical pixels. (Proposals are roughly 1 MB per frame with roughly 1000 lines by 1000 horizontal points). This typically results in a factor of 2-3 improvement in the angle of the vertical and horizontal fields. The majority of HDTV proposals also change the aspect ratio to 16/9 from 4/3 -- making the image more "movie-like".

The following table summarizes a few of the more conventional analog HDTV proposals in comparison with existing TV systems[2]. (Note Grand Alliance and other fully digital proposals are not included in this table.)

Name	Prog. or inter.	Total lines	Active lines	Vert. res.	Horz. res.	Opt. view dist.	Asp. ratio	Vert. field	Horz. field
HDTV USA, analog	p	1050	960	675	600	2.5H	16/9	23 deg	41 deg
HDTV Europe, analog	p	1250	1000	700	700	2.4	16/9	23 deg	41 deg
HDTV NHK	i	1125	1080	540	600	3.3	16/9	17 deg	30 deg
NTSC conv.	i	525	484	242	330	7	4/3	8 deg	11 deg
NTSC prog.	p	525	484	340	330	5	4/3	12 deg	16 deg
PAL conv.	i	625	575	290	425	6	4/3	10 deg	13 deg
PAL prog	p	625	575	400	425	4.3	4/3	13 deg	18 deg
SECAM conv.	i	625	575	290	465	6	4/3	10 deg	13 deg
SECAM prog	p	625	575	400	465	4.3	4/3	13 deg	18 deg

NOTE: The aspect ratio of the picture is defined to be the ratio of the picture width W to its height H. The optimal viewing distance (expressed in picture heights, H) is the distance at which the eye can just perceive the detail elements in the picture.

III. Issues in HDTV

A. Bandwidth limitations

A best, one cycle of an analog video frequency can provide information to two pixels. (NOTE: This is AT BEST -- it can easily be argued that one cycle only provides full video information to one pixel!)

A conventional NTSC image has 525 lines scanned at 29.97 Hz with a horizontal resolution of 427 pixels. This gives 3.35 MHz (assuming 2 pixels per video cycle) as a minimum bandwidth to carry the video information without compression.

If one decides to move to an HDTV image that is 1050 lines by 600 pixels (keeping the same frame rate), then this means a bandwidth of 18 MHz. Clearly we have a problem here -- as the current terrestrial channel allocations are limited to 6 MHz!

(As an aside, the word "terrestrial" as used by TV people means conventional wireless TV transmission. This is to differentiate it from satellite or cable.)

The options for terrestrial broadcast (assuming a 20 MHz bandwidth) are roughly as follows:

1. Change the channel allocation system from 6 MHz to 20 MHz.

2. Compress the signal to fit inside the 6 MHz existing bandwidths

3. Allocate multiple channels (2 with compression or three without) for the HDTV signal

Options 1 and 2 are virtually incompatible with current NTSC service. About the only possibility for maintaining compatibility is simultaneous broadcast of NTSC information over certain channels and HDTV information over other channels.

Option 3 does allow compatibility -- as the first 6 MHz of the signal could keep to the standard NTSC broadcasting and the remaining be additional augmentation signal for HDTV. Typically, in this type of augmentation system, an existing VHF channel would be tied to one (or two) UHF channels. The VHF channel would carry information similar to the current NTSC signal and the UHF channel (or channels would carry augmented high resolution information).

B. Distribution -- terrestrial? satellite? cable?

Advocates for HDTV systems fall into two major categories. There are those that feel that these systems will ultimately be successful outside the conventional channels of terrestrial broadcasting. Equally vehemently, are those that think HDTV can and must use existing terrestrial broadcast channels.

NTSC terrestrial broadcast channels are essentially 6 MHz wide. Service in a given area (roughly a 50 mile circle around the broadcast station) is typically offered on every other channel in order to avoid interference effects. A relatively small range of channels are available (channels 2-69, 55-88, 174-216, 470-806 MHz).

In 1987, the FCC issued a ruling indicating that the HDTV standards to be issued would be compatible with existing NTSC service, and would be confined to the existing VHF and UHF frequency bands.

In 1990, the FCC announced that HDTV would be simultaneously broadcast (rather than augmented) and that its preference would be for a full HDTV standard (rather than the reduced resolution EDTV).

These two decisions are very interesting, as they are almost contradictory. The 1987 decision is clearly leaning toward a augmentation type format -- where the NTSC service continues intact and new channels provide HDTV augmentation to the existing. The 1990 decision is a radical and non-conservative approach -- one which basically removes the requirement for compatibility by allowing different HDTV and NTSC standards to exist simultaneously for a period of years. Then the NTSC is gradually faded out as the HDTV takes over.

Now, the FCC does not have jurisdiction over channel allocation in cable networks. Thus, there is the rather interesting question of what the cable TV companies will do. They have a number of interesting options. They can continue to broadcast conventional NTSC, they can install 20 MHz MUSE-type HDTV systems (or other types of HDTV systems), or they can go with the digital Grand Alliance systems. This presents the interesting possibility of two different HDTV standards, one for terrestrial broadcast and one for cable broadcast.

C. Interlaced versus non-interlaced.

The maximum vertical resolution promised by a particular TV system is greater than the actual observed resolution. The reduction in resolution is due to the possibility of a picture element (pixel) falling "in-between" the scanning lines. Measurement gives a effective resolution of about 70% of the maximum resolution (the Kell factor) for progressively scanned (i.e. not interlaced) systems. If the image is interlaced, then the 70% factor only applies if the image is completely stationary. For non-stationary interlaced images this resolution falls to about 50%.

Interlacing also produces serrated edges to moving objects, as well as flicker along horizontal edges (glitter) and misaligned frames. As a consequence of the many problems associated with interlacing, a number of the HDTV proposals are for progressively scanned (not interlaced) service. Notice that these apply both to new ideas for HDTV, and to upgrades of the existing NTSC, PAL and SECAM systems as well. (Although initiating progressive scanning on conventional service does create compatibility problems, some of these techniques offer improved performance to NTSC/PAL/SECAM without the associated problems of moving to "true" HDTV.)

D. Compression

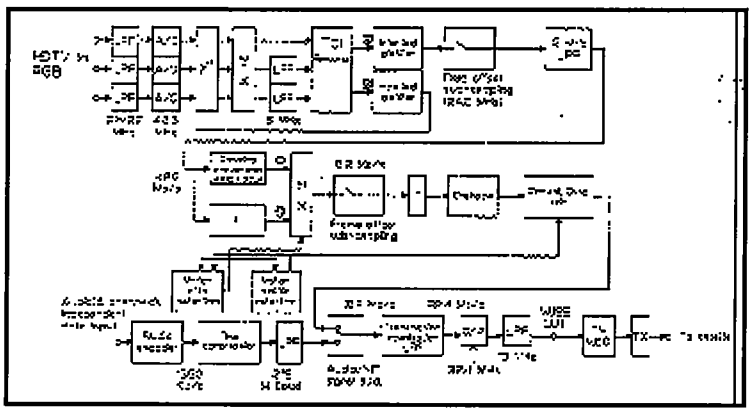
Even if extra channel space is available -- it is usually not enough for the very wide bandwidths of HDTV. As an example, the current NHK satellite broadcast system in Japan (the only "in-service" HDTV system) requires 20 MHz, but only has 8.15 MHz available per channel from direct satellite broadcast.

Thus, some type of compression is typically required. Interestingly enough, although these compression schemes result in analog signals -- they are digitally implemented. Thus, the line between "digital" and "analog" HDTV begins to blur.

1. Signal compression in the MUSE system

The MUSE currently used for satellite HDTV service in Japan is a modification of the NHK HDTV standard for direct broadcast satellite service. The wide bandwidth of the NHK HDTV system is too large for the 8.15 DBS service. As a consequence, the signal must be compressed.

The NHK HDTV signal is initially sampled at 48.6 Ms/s. This signal controls two filters, one responsive to stationary parts of the image -- one responsive to moving parts. The outputs of the two filters are combined and then sampled at the sub-Nyquist frequency of 16.2 MHz. The resulting pulse train is then converted by to analog with a base frequency of 8.1 MHz[3].



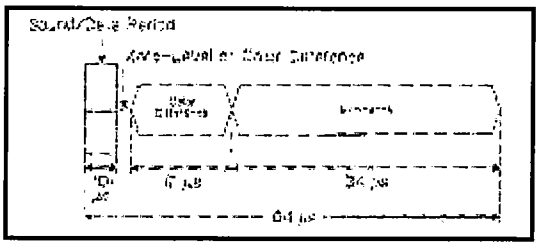
What is happening here is that the subsampling results in successive transmission of signals representing every third picture element. Thus, three adjacent picture elements in the receiver actually represent three successive scans of the same line. Stationary objects are not bothered by this, and appear at their full resolution. However, moving objects do not reoccur in their proper positions and create a smearing effect. This is not a real problem with moving objects in the scene (as the human eye is not very sensitive to this either). However, it does present a problem during camera panning, where the overall image suffers about a 50% drop in resolution -- while the human eye does not.

2. Signal compression in the MAC system

The MAC system was originally proposed as the analog compression standard for European HDTV. Under the original plans, HDTV broadcasts using MAC would be standard in 1995. However, for a variety of reasons, MAC did not make it in Europe[4]. In fact, MAC has died so hard that Europe may simply wait until the US develops an all digital HDTV standard and then use a 50 Hz modified version of it. (As an aside, an interesting situation occurs with European HDTV systems. The peripheral vision is much more sensitive to contrast and movement than foveal vision. As a consequence, the 50 Hz field rate (25 Hz frame rate) has been found to be too slow. The edges of a 50 Hz HDTV image will flicker. Thus, most European HDTV systems advocate 100 Hz.)

However, in spite of the political death of MAC, the technological aspects of the compression are very interesting and worth knowing about. Basically the MAC (multiplexed analog components) compression system fits the luminance and chrominance information into the horizontal line scan in a sequential way. In other words, the R-Y information is sent on one scan, and the B-Y on the next scan.

The color difference and luminance information is sent in a time multiplexed fashion. Looking at the signal in time, the first part of the signal is audio information, followed by chrominance (R-Y or B-Y), followed by luminance[5].



In order to get the signal into this form require some serious digital processing. Initially, the luminance, R-Y and B-Y signals are sampled and stored digitally. The luminance is sampled at 13.5 MHz and the color difference signals at 6.75 MHz. Then a 3/2 compression on the luminance and a 3/1 compression on the chrominance is performed.

Now, the three signals are read out to produce pulse trains, and then back converted into analog form. The time compression resulting from this operation allows them to be time domain multiplexed in order to fit within the 64 uS horizontal scan time.

IV. MUSE -- or how the Japanese have gone toward HDTV

As of today, Japan is the only country actually broadcasting HDTV services. Approximately 30,000 receivers and 100,000 converters have been sold to customers of this service[6]. It is widely believed that the establishment of this analog broadcast service essentially eliminates the possibility of starting a digital satellite HDTV service in Japan.

The history of this begins in 1968, when Japan's NHK began a massive project to develop a new TV standard. This 1125 line system, is an analog system which uses digital compression techniques. It is a satellite broadcast system which is not compatible with current Japanese NTSC terrestrial broadcast. (This actually makes a lot of sense for Japan, as they are a single group of islands easily accessed by one or two satellites).

The MUSE system as originally developed by NHK was a 1125 line, interlaced, 60 Hz, system with a 5/3 aspect ratio and an optimal viewing distance of roughly 3.3H. The pre-compression bandwidth for Y is 20 MHz, and the pre-compression bandwidth for chrominance was 7 MHz. As time has passed, this standard has been altered and upgraded.

The various standard MUSEs are summarized below[7].

	lines per frame	field rate	Y bandwidth	C bandwidth - wide	C bandwidth - narrow	aspect ratio
NHK-1980	1125 lines	60 Hz	20 MHz	7 MHz	5.5 MHz	5/3
MUSE 1986	1125 lines	60 Hz	20 MHz	6.5 MHz	5.5 MHz	5/3
SMPTE 1987 (studio)	1125 lines	60 Hz	30 MHz	30 MHz	30 MHz	16/9

In considering how to broadcast this signal, Japanese engineering immediately rejected conventional vestigial sideband broadcasting (i.e. broadcasting methods similar to NTSC). They immediately jumped to the idea of using satellite broadcast (no doubt helped by the geography of the Japanese Islands, which economically support satellite broadcast.)

The Japanese initially explored the idea of FM modulation of a conventionally constructed composite signal. (This would be a signal similar in structure to the Y/C NTSC signal - with the Y at the lower frequencies and the C above.) Approximately 3 kW of power would be required, in order to get 40 dB of signal to noise for a composite FM signal in the 22 GHz satellite band[8]. This was virtually incompatible with satellite broadcast!

So, the next idea was to use separate transmission of Y and C. This drops the effective frequency range and dramatically reduces the required power. Approximately 570 W of power (360 for Y and 210 for C) would be required in order to get 40 dB of signal to noise for a separate Y/C FM signal in the 22 GHz satellite band[9]. This is much more feasible!

There is one more power saving that appears from the character of the human eye. Lack of visual response to low frequency noise allows significant reduction in transponder power if the higher video frequencies are emphasized prior to modulation at the transmitter and de-emphasized at the receiver. This method was adopted, with crossover frequencies for the emphasis/de-emphasis at 5.2 MHz for Y and 1.6 MHz for C. With this in place, the power requirements drop to 260 W of power (190 for Y and 69 for C)[10].

As mentioned earlier (see the section on compression) -- the problem of fitting the combination Y/C signal into the 8.15 MHz satellite bandwidth was solved by digital compression. Summarizing the previous discussion, the NHK HDTV signal is initially digitally sampled at 48.6 Ms/s. This signal controls two filters, one responsive to stationary parts of the image -- one responsive to moving parts. The outputs of the two filters are combined and then sampled at the sub-Nyquist frequency of 16.2 MHz. The resulting pulse train is then converted by to analog with a base frequency of 8.1 MHz[11].

V. The Grand Alliance -- all digital HDTV and where the US is going from here

A. History:

In 1987, the FCC issued a ruling indicating that the HDTV standards to be issued would be compatible with existing NTSC service, and would be confined to the existing VHF and UHF frequency bands.

By the end of 1988, the FCC had received 23 different proposals for HDTV or EDTV standards. These were all analog (or mixed analog/digital systems like MUSE) and explored a variety of different options for resolution, interlace and bandwidth.

In 1990, the FCC announced that HDTV would be simultaneously broadcast (rather than augmented) and that its preference would be for a full HDTV standard (rather than the reduced resolution EDTV).

On May 31, 1990 General Instrument Corp. submitted the first proposal for an all digital HDTV system. By December 1990, ATRC announced its digital entry, followed quickly by Zenith and AT&T, then MIT. Thus there were four serious contenders for digital HDTV, as well as a modified "narrow" MUSE and an EDTV proposal. During the following year, these systems were tested.

In February 1993, the FCC made the key decision for an all digital technology -- but could not decide among the four contenders. Therefore, after some fuss, a recommendation was made to form a "Grand Alliance" composed of AT&T, GI, MIT, Philips, Sarnoff, Thomson and Zenith. This Grand Alliance would take the best features of the four systems and develop them into an HDTV standard. Most of the remainder of 1993 was devoted to establishing the features of this new standard.

During 1994, the system was constructed and 1995 is slated for testing. If all goes well, the FCC may be setting this standard by the end of 1995.

B. The basic standard

The Grand Alliance standard differs from all existing TV standards in three major ways. First, it is all digital standard -- to be broadcast with a packet transmission. Second, it supports multiple formats. Third, it is designed to be primarily compatible with computers rather than existing NTSC televisions.

Summarizing the various formats[12].

active lines	active horizontal pixels	aspect ratio		frame rate in Hz*
720	1280	16/9	progressive	24, 30 or 60
1080	1920	16/9	interlaced	60
1080	1920	16/9	progressive	24, 30

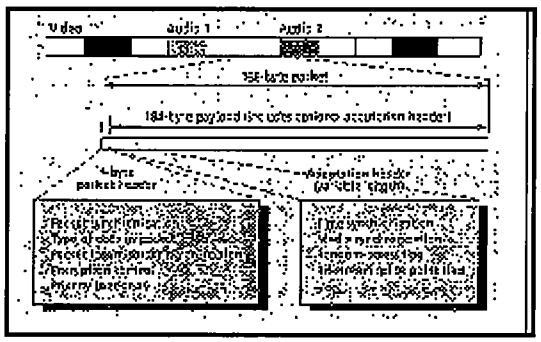
* Spectrum reports that "all the formats are supported with NTSC frame rates, 59.94Hz, 23.97 Hz, and 29.97 Hz."

C. Compression

The compression algorithms use both a motion compensated and discrete cosine transform (DCT) algorithm. The motion compensation exploits temporal redundancy. The DCT exploits spatial redundancy. MPEG-2 syntax will be used -- because it is already well established, will aid in world-wide acceptance, and will smooth the road to computer and multimedia

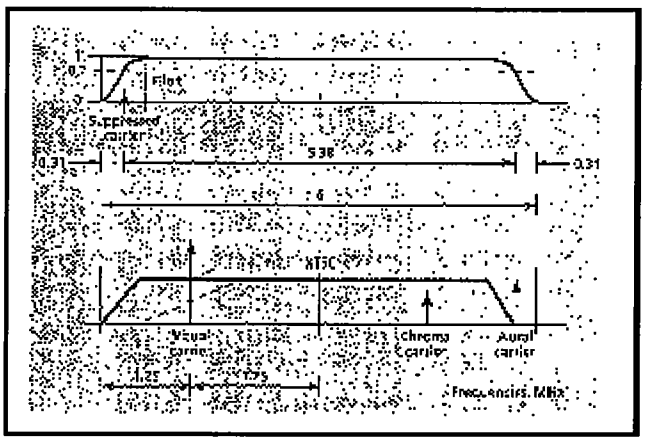
compatibility. Audio will be supported by Dolby AC-3 digital audio compression. This will include full surround sound.

The core of the Grand Alliance concept is a switched packet system. Each packet contains a 4-byte header, and a 184 byte data word. Each packet contains either video, audio, or auxiliary information. For synchronization, the program clock reference in the transport stream contains a common time base. For lip sync between audio and video, the streams carry presentation time stamps that instruct the decoder when the information occurs relative to the program clock[13].



The terrestrial transmission system is a 8-level vestigial sideband (VSB) technique. The 8-level signal is derived from a 4-level AM VSB and then trellis coding is used to turn the 4-level signals into 8-level signals. Additionally, the input data is modified by a pseudo-random scrambling sequence which flattens the overall spectrum. Cable transmission is by a 16-level VSB technique without trellis coding.

Finally, a small pilot carrier is added (rather than the totally suppressed carrier as is usual in VSB). This pilot carrier is placed so as to minimize interference with existing NSTC service[14].



The Grand Alliance system is clearly designed with future computer and multimedia applications in mind. The use of MPEG-2 will permit HDTV to interact with computer multimedia applications directly. For example, HDTV could be recorded on a multimedia computer, and CD/ROM applications could be played on HDTV systems.

A/V Products
- Audio Accessories
- DVD Players
- Furniture
- HDTV Tuner/Receivers
- Receivers/Amplifiers
- Speakers
- Video Accessories
- Video Distribution
- Video Processor
- Video Switcher

Displays
- Digital TV/HDTV
- CRT Monitors
- LCD Monitors
- Plasmas
- Projectors

Cables
- Audio Cables
- A/V Cables
- Component Cables
- DVI Cables
- PC Cables
- VGA to BNC/RCA
- VGA Cables

PC Products
- HTPC Cases
- CD/DVD/Recorders
- SCSI/Firewire Cards
- Floppy Drives
- Hard Disk
- HDTV Tuner Cards
- Keyboard/Mouse
- Memory
- Motherboards
- Power Supplies/Fans
- Processors
- Software

HDTV Frequently Asked Questions

What is High-Definition TV (HDTV)?

What is Digital Television?

Little has changed in television since it's original introduction. The major change in the NTSC television standard last came when we moved to Color. The FCC mandate to change our broadcast standards from NTSC analog to ATSC digital broadcasting is big bold move, requiring changes in everything from the way the studios shoot video, the format that's transmitted, to the equipment we use to receive and watch broadcasts. Press Releases from ATSC

The federal mandate grants the public airwaves to the broadcasters to transmit digital TV in exchange for return of the current analog NTSC spectrum, allowing for a transition period in the interim. At the end of this period scheduled for 2006, broadcasters must be fully converted to the 8VSB broadcast standard. FCC's Digital Television Website.

Will it require new equipment?

Yes, it does. The broadcasts signal is sent in digital format as data (1's and 0's) and transmitted over the air where it will need to be converted at the receiving end to actual video. This conversion requires a "decoder" otherwise known as the "set-top-box".

There are 18 approved formats for digital TV broadcasts, but only two (720p/1080i) are proper definition of the term HDTV. Sets that do not have any decoding capabilities but can display the high-resolution image is often labeled as "HD-Ready" a term that describes 80% or more of the Digital TVs on the market. Finally, new formats are currently being reviewed or starting to appear on the market today. For more information, see: HDTV equipment standards. Also Visit ISFTV article Display Types and Technologies on the Miller Channel.

The Monkey Wrench

Well, like everything else in our current market, we didn't expect to escape the built-in obsolescence factor, a "gotcha" for all new compelling formats that can translate into many eyeball views. The war is on for the financial niches that need to be carved. The studios refuse to show content for fear of piracy, the manufacturers understandably are afraid of alienating their customer's reasonable expectations of timeshifting, and the coming earthquake of possible incompatibilities of today's equipment to tomorrow's transmissions is enough to put a damper on the whole transition. Add to that these facts:

1. Studios want "broadcast flags" inserted in all public transmissions by our big four national broadcasters to make it difficult to record these broadcasts. They also have a problem with digital recording devices that

Sound Cards
Video Cards

allow for commercial skipping.

2. Cable companies who service majority of all TV viewers have faltered in delivering HDTV. Then there is the issue of "digital cable", conceivably the most deceiving misnomer that tries to piggyback on HDTV. Worse yet, the broadcast format they employ will not be the same as the FCC mandated ATSC standard. Not only will two separate decoders be required to watch both QAM (Cable) and 8VSB (NBC, CBS, ABC, and Fox) broadcasts but we also must now consider .....

3. ....Satellite TV. With their "serve anywhere" capability and yet another modulation scheme that requires a third decoder. Even worse, between the cable and satellite operators, there are no real consensus on what type of connection they will employ for timeshifting. The battle of Firewire vs. DVI and and the accompanying encryption format and the consequences of both for Analog (Component and RGB) video only digital TV owners rages on.

Two steps back but one step forward

D-VHS come of age

Digital-VHS format features the low-priced storage medium, tape. In today's optical disk environment, linear tape seems an unlikely choice to rally behind. With introduction of D-Theater format championed by JVC, major studio movies are now available in High-Definition glory with a compatible tape player like the JVC (check for D-Theater compatibility, without it, the movies won't play). If you're a HT enthusiasts, this is a good interim solution for HDTV.

Salvation comes from odd quarters, and D-VHS would well fall into the category of a product that you'd want to hate but end up embracing for it's familiarity.

Before you start your booing, consider how desirable HDTV recording is, and what a boon HDTV movies are to the market. As unattractive as the linear tape seems, it's the highest bitrate you can buy for pre-recorded material. If you are the type that willingly pays for the best technology available today, D-VHS tapes provides the best picture quality, period.

Before you jump on the D-VHS bandwagon, research what it is and what other accessories will be required to achieve your expectations of video storage and viewing. D-Theater tapes are finally making their appearance in the market place and the faithful have given their thumbs up. I suspect a fair amount of activities overseas as the first forms of high-definition become available for global consumption.

- Defining High-Definition and HD-Ready TV
- What programs are available on Digital and High-Definition TV