What’s DTV?

Images and sound are captured using digital technology.

- **Higher Picture Resolution**
  - It uses the same amount of channel bandwidth as the current analog system to transmit four times more information. This capability translates to much better quality in sound and picture (known as “high definition” TV).

- **Multicasting**
  - It allows the transmission of several "standard definition" TV programs at once – called “multicasting”, with pictures and sound quality equal to or better than is generally available today.
What’s DTV?

• Better Picture Quality
  – Digital pictures will be free from "ghosts" and "snow" that can affect analog transmissions

• New Type of Broadcasting Service
  – Broadcasters can simultaneously transmit a variety of interactive video and data services that are not possible with “analog” technology. It is a new type of broadcasting service that will change your television viewing experience.
Digital TV (DTV)

• Refers to a group of 18 U.S. digital broadcast formats set by the Advanced Television Systems Committee (ATSC) to replace NTSC, the current but aging television system.

• Each of the formats uses a different combination of standards for resolution, aspect ratio, frame rates, and progressive/interlaced scanning methods.

• Digital television and high-definition television (HDTV) are not the same thing. Digital television refers to the type of video signal received and displayed, while HDTV refers to the image resolution displayed.
Digital Broadcast Timeline (USA)

• April, 1997 - FCC gives broadcasters $70 billion worth of spectrum to broadcast digital alongside analog until 2006. FCC also mandates that in 2006 all broadcasts must be fully digital.
• November, 1998 - PBS, ABC, NBC, CBS, and Fox are committed to broadcasting digitally in the top ten U.S. markets (30% of viewers) by Nov. 1.
• May, 1999 - Broadcasters must have digital stations in top 30 U.S. markets (50% of viewers).
• 2006 - Broadcasters must relinquish extra broadcast spectrum and broadcast only digital.
Basic Concepts of TV

• Interlaced and Progressive Scanning
• Frame Rate
• Vertical Scan Lines and Horizontal Pixels
• Aspect Ratios
Interlaced Scan & Progressive Scan

- Interlaced scanning is a broadcast process used in television sets whereby odd- and even-numbered lines of a picture are scanned and displayed consecutively as two separate fields and superimposed to create one frame, or a complete picture, on the screen.

- Progressive scanning is a process by which a digital television can scan a complete image – not just half of it as with interlaced scanning – all at once. Images, especially ones in motion, appear smoother to your eye and you don't have the flicker as with analog televisions.
Frame Rate

- Motion picture on your TV is generated by a series of still pictures that changes from picture to picture at a very fast rate. This rate is measured by the number of still pictures (frames) displayed within one second of time. The higher the frame-rate, the smoother the picture displayed.
Vertical Scan Lines and Horizontal Pixels

• Vertical Scan Lines: Vertical scan lines refer to the number of horizontal lines a television can display to create an image. As the number of lines increase, more information is displayed, resulting in better picture quality. Traditional analog TVs can display approximately 480 lines, while high definition television can display up to 1080 lines.

• Horizontal Pixels: Each horizontal line in a TV is made up of individual dots (pixels). The higher the number of pixels, the finer the TV picture becomes.
Aspect Ratio - 4:3 and 16:9

- 4:3 - This is the traditional aspect ratio used for most current analog television screens. The displayed image is 4 units wide by 3 units tall. Most current TV programming is in 4:3 format.

- 16:9 - This is a widescreen aspect ratio used for video display. The displayed image is 16 units wide by 9 units tall, similar to the screen at a movie theater.
Aspect Ratio - 4:3

• Established in the late 19th century by Thomas Edison, the 4:3 aspect ratio was officially adopted by the Society of Motion Picture Engineers as the first film industry aspect ratio standard.
• Since the standard existed before the predominance of television, the television industry also used the 4:3 standard when it started broadcasting in the 1930's.
Aspect Ratio – 16:9

• Motion pictures are filmed in various widescreen aspect ratios. Common aspect ratios for file include 2.35:1, 1.85:1, 2.22:1 or 1.65:1. Using a formula which took into account all the common movie aspect ratios, a compromise of 16:9 was established in the 1980's. The 16:9 standard was then adopted by those responsible for developing HDTV in the US and worldwide.
Letterboxing or Black bars

- When watching sources with a 16:9 format such as widescreen DVDs or HDTV broadcasts, black bars will appear on the top and bottom of your 4:3 screen. The source material (DVD or HDTV signal) will be scaled to fit proportionally.

- When watching video sources that broadcast in the 4:3 format, such as standard NTSC TV broadcasts or computer presentations, black bars will appear on the sides of your display and the source material will be scaled to fit proportionally.
4:3 Format Video on 16:9 Screen

- Normal mode
- Wide mode
- Fill mode
Screen Size

4:3

16:9

22"
24"
25"
27"
38"

32"
34"

42"
46"
50"
55"
60"
65"
70"
DTV Formats

- Standard Definition (SDTV): 480i.
- High Definition (HDTV): 720p(1280x720), 1080i(1920x1080)

<table>
<thead>
<tr>
<th>FORMAT</th>
<th>Vertical resolution (lines per frame)</th>
<th>Horizontal resolution (pixels per line)</th>
<th>Aspect ratio</th>
<th>Audio</th>
<th>Pixel count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Definition (SD)</td>
<td>480 interlaced</td>
<td>704</td>
<td>4:3</td>
<td>Dolby Digital 5.1-channel</td>
<td>337,920</td>
</tr>
<tr>
<td>Enhanced Definition (ED)</td>
<td>480 progressive</td>
<td>704</td>
<td>4:3 or 16:9</td>
<td>Dolby Digital 5.1-channel</td>
<td>337,920</td>
</tr>
<tr>
<td>High Definition (HD)</td>
<td>720 progressive</td>
<td>1280</td>
<td>16:9</td>
<td>Dolby Digital 5.1-channel</td>
<td>921,600</td>
</tr>
<tr>
<td>High Definition (HD)</td>
<td>1080 interlaced</td>
<td>1920</td>
<td>16:9</td>
<td>Dolby Digital 5.1-channel</td>
<td>2,073,600</td>
</tr>
<tr>
<td>NTSC (analog)</td>
<td>480 interlaced</td>
<td>450 (equivalent)</td>
<td>4:3</td>
<td>Stereo (2-channel)</td>
<td>216,000</td>
</tr>
</tbody>
</table>

Source: Advanced Television Systems Committee
Resolution by Active Pixels

Active Pixels

Broadcast Format

<table>
<thead>
<tr>
<th>Format</th>
<th>Active Pixels</th>
</tr>
</thead>
<tbody>
<tr>
<td>480i</td>
<td>153600</td>
</tr>
<tr>
<td>480p</td>
<td>307200</td>
</tr>
<tr>
<td>720p</td>
<td>921600</td>
</tr>
<tr>
<td>1080i</td>
<td>1036800</td>
</tr>
</tbody>
</table>
HDTV refers to a complete product/system with the following minimum performance attributes:

- **Receiver** – Receives ATSC terrestrial digital transmissions and decodes all ATSC Table 3 video formats
- **Display Scanning Format** – Digital transmission; has active vertical scanning lines of 720 progressive (720p), 1080 interlaced (1080i), or higher
- **Aspect Ratio** – Capable of displaying a 16:9 image
- **Audio** – Receives and reproduces, and/or outputs Dolby Digital audio
HDTV monitor refers to a monitor or display with the following minimum performance attributes:

- **Display Scanning Format** – Has active vertical scanning lines of 720 progressive (720p), 1080 interlaced (1080i) or higher.

- **Aspect Ratio** – Capable of displaying a 16:9 image. In specifications found on product literature and in owner’s manuals, manufacturers are required to disclose the number of vertical scanning lines in the 16:9 viewable area, which must be 540p, 810i or higher to meet the definition of HDTV.
EDTV refers to a complete product/system with the following minimum performance attributes:

- **Receiver** – Receives ATSC terrestrial digital transmissions and decodes all ATSC Table 3 video formats
- **Display Scanning Format** – Digital transmission; has active vertical scanning lines of 480 progressive (480p) or higher
- **Aspect Ratio** – None specified
- **Audio** – Receives and reproduces, and/or outputs Dolby Digital audio.
**EDTV Monitor** refers to a monitor or display with the following minimum performance attributes:

- **Display Scanning Format** – Has active vertical scanning lines of 480 progressive (480p) or higher.
- **Aspect Ratio** – None specified.
Standard Definition Television (SDTV)

SDTV refers to a complete product/system with the following performance attributes:

- **Receiver** – Receives ATSC terrestrial digital transmissions and decodes all ATSC Table 3 video formats, and produces a useable picture
- **Display Scanning Format** – Analog transmission; has active vertical scanning lines less than that of EDTV
- **Aspect Ratio** – None specified
- **Audio** – Receives and reproduces useable audio.
1080i vs. 720p

• How do 1080i and 720p compare? 1080i actually has higher resolution than 720p, but doesn't render motion quite as well. 720p-with its progressive scanning-delivers smoother motion (especially important for fast-moving action, such as in sports) but has lower resolution than 1080i. Still great, but lower. (Don't worry; any HDTV receiver can receive both formats, and a true HDTV television can display both formats.)
HD "Compatible" or HD-"Ready"?

- Some televisions are digital and HD-ready, which means that you can add a tuner to the television at some later date in order to receive HD signals. These sets are generally called HD-compatible or HD-ready and are somewhat less expensive than a true HDTV. However be aware that not all TVs being promoted as “HD-compatible” are truly capable of displaying HD signals. If the television display is not true HD the signal must be downgraded for an image to be displayed. This difference needs to be understood before purchasing an HDTV in order for a consumer’s expectations to be met.
Main TV broadcasting system

- Analogue television systems:
  - NTSC
  - PAL
  - SECAM

- Digital television systems:
  - Japan: ISDB
  - Europe: DVB
  - America: ATSC DTV
## Analogue television systems

<table>
<thead>
<tr>
<th>Standard</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTSC</td>
<td>U.S., Canada, Mexico, some parts of Central and South America, Japan, Taiwan, and Korea.</td>
</tr>
<tr>
<td>PAL</td>
<td>U.K., Germany, Spain, Portugal, Italy, China, India, most of Africa, and the Middle East.</td>
</tr>
<tr>
<td>SECAM</td>
<td>France, Russia, Eastern Europe, and some parts of the Middle East.</td>
</tr>
</tbody>
</table>
NTSC

• In the 1950’s, the National Television Standards Committee set standards for analog television in the United States, Japan and Canada that are still in place today. NTSC refers to both the committee and the standards.

• NTSC is the U.S. government agency that established the analog color television standard in use since 1953. The NTSC standard currently is being replaced by the new digital television standard (ATSC) advocated by the FCC.
NTSC

• NTSC is based on a 525-line, 60 fields/30 frames-per-second at 60Hz system for transmission and display of video images.

• This is an interlaced system in which each frame is scanned in two fields of 262 lines, which is then combined to display a frame of video with 525 scan lines.

• NTSC is the official analog video standard in the U.S., Canada, Mexico, some parts of Central and South America, Japan, Taiwan, and Korea.
PAL

• PAL is based on a 625 line, 50 field/25 frames a second, at 50HZ system. The signal is interlaced, like NTSC, into two fields, composed of 312 lines each.

• PAL has a frame rate closer to that of film. PAL has a 25 frames per second rate, while film has a frame rate of 24 frames per second.

• Countries on the PAL system include the U.K., Germany, Spain, Portugal, Italy, China, India, most of Africa, and the Middle East.
SECAM

- SECAM is the "outlaw" of analog video standards. Like PAL, it is a 625 line, 50 field/25 frame per second interlaced system, but the color component is implemented differently than in either PAL or NTSC.

- Countries on the SECAM system include France, Russia, Eastern Europe, and some parts of the Middle East.
# Digital Television Systems

<table>
<thead>
<tr>
<th>Country / Standard</th>
<th>Satellite, DSTV</th>
<th>Cable, DCTV</th>
<th>Terrestrial, DTTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>DVB-S</td>
<td>DVB-C</td>
<td>DVB-T / COFDM</td>
</tr>
<tr>
<td>USA</td>
<td>DVB-S, DSS</td>
<td>SCTE-031</td>
<td>ATSC / 8-VSB</td>
</tr>
<tr>
<td>Canada</td>
<td>DVB-S</td>
<td>---</td>
<td>ATSC / 8-VSB</td>
</tr>
<tr>
<td>Japan</td>
<td>DVB-S</td>
<td>DVB-C</td>
<td>ISDB-T</td>
</tr>
<tr>
<td>Korea</td>
<td>DVB-S</td>
<td>---</td>
<td>ATSC / 8-VSB</td>
</tr>
<tr>
<td>Australia</td>
<td>DVB-S</td>
<td>---</td>
<td>DVB-T / COFDM</td>
</tr>
<tr>
<td>China</td>
<td>DVB-S</td>
<td>DVB-C</td>
<td>(T.B.D.)</td>
</tr>
<tr>
<td>Taiwan</td>
<td>DVB-S</td>
<td>DVB-C</td>
<td>ATSC / 8-VSB</td>
</tr>
</tbody>
</table>
Introduction to ATSC

- **Advanced Television Systems Committee**
- Formed in September 1982
- ATSC currently has around 200 members
  - Broadcasters
  - Manufacturers
  - Network operators
  - Regulatory bodies
- Co-ordinates television standards among different communications media focusing on digital television, interactive systems, and broadband multimedia communications. Also developing digital television implementation strategies
- Adopted by U.S., Canada, S. Korea, Taiwan and Argentina
### 18 U.S. digital broadcast formats

<table>
<thead>
<tr>
<th>Format</th>
<th>Vertical Scan Lines</th>
<th>Horizontal Pixels</th>
<th>Aspect Ratio</th>
<th>Scan Mode</th>
<th>Frame rate (fps)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HDTV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1080p</td>
<td>1080</td>
<td>1920</td>
<td>16:9</td>
<td>Progressive</td>
<td>24 / 30</td>
</tr>
<tr>
<td>1080i</td>
<td>1080</td>
<td>1920</td>
<td>16:9</td>
<td>Interlaced</td>
<td>30</td>
</tr>
<tr>
<td>720p</td>
<td>720</td>
<td>1280</td>
<td>16:9</td>
<td>Progressive</td>
<td>24 / 30 / 60</td>
</tr>
<tr>
<td><strong>EDTV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>480p</td>
<td>480</td>
<td>704</td>
<td>16:9</td>
<td>Progressive</td>
<td>24 / 30 / 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4:3</td>
<td>Progressive</td>
<td>24 / 30 / 60</td>
</tr>
<tr>
<td></td>
<td>640</td>
<td>4:3</td>
<td>Progressive</td>
<td></td>
<td>24 / 30 / 60</td>
</tr>
<tr>
<td><strong>SDTV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>480i</td>
<td>480</td>
<td>704</td>
<td>16:9</td>
<td>Interlaced</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4:3</td>
<td>Interlaced</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>640</td>
<td>4:3</td>
<td>Interlaced</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>
Introduction to DVB

- Digital Video Broadcasting organization
- Formed in September 1993
- DVB now has more than 300 members
  - Broadcasters
  - Manufacturers
  - Network operators
  - Regulatory bodies
- Mission: “The creation of a harmonious digital broadcast market for all service delivery media”
- Mainly covers Europe but also promoting in U.S. and Japan
- Competes against ATSC (U.S.) and ISDB (Japan)
## Comparison of ATSC, DVB, ISDB

<table>
<thead>
<tr>
<th></th>
<th>ATSC</th>
<th>DVB-T</th>
<th>ISDB-T</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Video compression</strong></td>
<td>MPEG-2</td>
<td>MPEG-2</td>
<td>MPEG-2</td>
</tr>
<tr>
<td><strong>Audio compression</strong></td>
<td>Dolby AC-3</td>
<td>MPEG-2</td>
<td>MPEG-2 Audio (AAC)</td>
</tr>
<tr>
<td><strong>Modulation</strong></td>
<td>8-VSB ~ 16-VSB</td>
<td>COFDM</td>
<td>COFDM</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>6 MHz</td>
<td>7-8 MHz</td>
<td>6.5 MHz</td>
</tr>
<tr>
<td><strong>Portable/mobile reception</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>Cheaper</td>
<td>Expensive</td>
<td></td>
</tr>
</tbody>
</table>
Transmission Platforms

• DTV is delivered in one of four ways
  – Terrestrial
  – Cable
  – Satellite
  – Broadband DSL
Adoption-Map (Cable)
Adoption-Map (Satellite)
Interface (Connections)

- Coaxial
- Composite Video
- S-Video
- Component Video
- RGB Video (D-sub 15 pin)
- DVI (Digital Video Interface)
- HDMI (High Definition MultiMedia Interface)
- SCART (Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléspecteurs)
Connections

• **Coaxial connection**
  Provides a basic connection from an antenna, Cable box or Satellite box to the TV.

• **Composite connection** (or RF connection)
  Three bundled cables that provide a better connection. Audio connections are made with the red and white cables and the yellow is used for a video connection.
Video Connections - Composite Video

- A type of video signal in which all information the red, blue, and green signals are mixed together.

- This is the type of signal used by televisions in the United States). Use this connector for analog NTSC video. The highest resolution it will support is 480i only. You cannot connect a 480p video signal through this connector.
Connections

• **S-Video connection**
  Superior video connection that provides high-quality picture performance.

• **Component Video Connection**
  Ultimate video connection for reception of separate green, blue and red luminance signals.
Video Connections - S-video

- This connector is a small, round input jack with four pins on it. Like the composite connector, the highest resolution you can connect to this input jack is 480i.
- It is an analog video format offering a higher quality signal than composite video, but a lower quality than RGB and component video.
- This mid-level format divides the signal into two channels - luminance and chrominance.
- Use this input jack if you want to watch video from a satellite receiver, digital TV set-top box, or DVD player and don't have a component (three-wire) video connection available.
Video Connections - Component Video

- Input jacks that are also known as RCA type and resemble composite video jacks. The difference is that component video jacks are colored green, blue, and red. Component video inputs will provide the highest quality 480i video and are a step up from S-video connections. If you have a 480p DVD player, you'll want to connect it to this input. Depending on the compatibility of a particular component input, you may also be able to connect a digital TV set-top receiver to these jacks. Some digital TVs provide two sets of component video inputs, with one set specifically designed for SDTV (480i and 480p), and the other intended for HDTV (720p/1080i). There should be a label near the connectors that distinguishes them.
Video Connections - RGB Video

• RGB video - These types of inputs use a 15-pin computer monitor connector, but they are capable of accepting both computer video and component video, including HDTV. Typically, this type of connector is used to interface with a desktop or laptop personal computer. It may also be used to connect a video game console. Some front projectors connect to all kinds of component video connections through this, and a separate video cable is required to hook up DVD players and digital TV set-top receivers. Many digital TV set-top receivers have RGB connectors that will interface with this jack.
DVI

- DVI (Digital Video Interface) is a multi-pin jack that looks like something you might see on the back of your PC. It enables uncompressed, standard and HD signals to be sent from an array of the newer video devices on the market. Signals are transferred in 100% pure digital, which is perfect for FlatTV. DVI-D carries digital signals and DVD-I can carry both analog and digital. The signal transmitted through a DVI connection is always encrypted with HDCP (High-Bandwidth Digital Content Protection) to prevent recording. Because there will come a day when signals transmitted through a digital connection without HDCP won’t be allowed by the broadcast industry, you can’t go wrong with DVI.
DVI (Digital Visual Interface)

• DVI (Digital Visual Interface) is an interface standard for the uncompressed transmission of digital video signals.
• DVI is used to connect high-definition sources and displays. DVI does not carry audio information, so separate left and right RCA jacks are needed.
• DVI was developed by the Digital Display Working Group (DDWG).
HDMI (High Definition MultiMedia Interface)

- HDMI is a digital video and audio connection system used to connect a variety of audio/video components, particularly high-definition video (HDTV).
- HDMI supports all HDTV formats (720p, 1080i, 1080p) along with support for up to eight channels of digital audio.
- HDMI transmits all digital signals without compression, allowing for superior quality without the presence of analog conversion artifacts.
HDMI (High Definition MultiMedia Interface)

- HDMI is compatible with the DVI (Digital Visual Interface) standard as well as HDCP copy protection.
- As a pure digital interface with high-bandwidth audio and video capabilities, HDMI provides the capability to transmit pure digital signals with just one wire compared to multiple analog connections that require potentially degrading digital-to-analog and analog-to-digital conversions.
Video Connections - DVI and HDMI

- Both of these connectors are 100% digital, not analog. DVI stands for digital visual interface and HDMI stands for high definition multimedia interface. The purpose of a DVI connector is to more precisely match a Plasma TV, LCD, or front/rear projection TVs to set-top receivers and DVD players. Because it does not convert any of the signals to analog at any point from source to screen, higher image quality is possible.
Video Connections - DVI and HDMI

- Both DVI and HDMI are intended also to be secure connectors. DVI is usually found with a level of content protection called High-bandwidth Content Protection. This interface protects against unauthorized copying of digital content. HDMI is a relatively new interface that will eventually replace DVI. Unlike DVI, HDMI will also carry digital audio signals and data, and HDMI connectors can be daisy-chained from one component to another in your TV or home entertainment system.
SCART

- SCART (Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléviseurs) is a French-originated standard and associated 21-pin connector for connecting audio and video equipment to TV sets.
- Also called Péritel (in France) and Euroconnector.
- SCART makes it easy to connect VCRs, DVD players, set-top boxes (Pay TV, analog or digital cable, terrestrial digital TV), home computers, gaming systems and other equipment to television sets with optimal quality.
Other Features

- 3:2 Pull down
- Closed-Caption
- Comb Filter
- DCR (Digital Cable Ready) & CableCard
- HDCP
- PIP / POP
- V-Chip
- Dolby® Digital
- SRS® Surround Sound
3:2 Pull Down

- 3:2 pull down is a process by which manufacturers add six frames to film’s original 24-frames-per-second format so that it can work within the NTSC standard, which is 30 fps. This helps keep the action from stuttering on your television. Unfortunately, this technique still leaves some distracting side effects like jerky, uneven motion – especially in fast-moving scenes.

![Diagram showing film and video formats](image-url)
Closed Captioning (CC)

• **Closed Captioning** (CC) allows deaf and hard of hearing / hearing-impaired people, people learning English as an additional language, people first learning how to read, and others to read a transcript of the audio portion of a video, film, or other presentation. As the video plays, text captions are displayed that transcribe, although not always verbatim, what is said and by whom and indicate other relevant sounds.

• The term "closed" in closed captioning means that not all viewers see the captions – only those who decode or activate them. This is distinguished from open captions, where the captions are visible to all viewers.
Comb Filter

- A comb filter separates the chrominance (color) and luminance (brightness) portions of a composite video signal.
- Comb filters are not used with S-Video (Y/C video) or component video connections (RB or Y, Pb, Pr), since those connections carry the chrominance and luminance separately.
- A filter is necessary for any composite video format, including laserdisc and television programming.
Comb Filter

• Comb filters are designed to clean up any fuzziness or artifacts brought in by the composite signal. Comb filters use various methods to clean up artifacts and therefore vary in effectiveness.

• **Analog Filters** Found on less expensive TV sets, usually on smaller screens (25” or less). These are less common today.

• **2-Line Digital** Separates Y and C signals while processing two consecutive horizontal scan lines and makes adjustments to lessen the effects of signal overlap.

• **3-Line Digital** Separates Y and C signals while processing three consecutive horizontal scan lines and makes adjustments to lessen effects of color bleed and dot crawl.

• **3-D Digital** Analyzes three consecutive scan lines as well as pre-analyzing previous and subsequent video fields to improve overall color accuracy and stability of image. It also effectively diminishes issues of color bleed and dot crawl.
Digital Cable Ready (DCR)

- A “plug-and-play” DTV is a television that you can plug directly into your cable system and receive analog and most digital cable services without the need for a set-top box. The cable and consumer electronics industries have dubbed these types of televisions “digital cable ready” or “DCR.”

- Plug-and-Play or Digital Cable Ready: A DTV or other device for digital cable customers that plugs directly into the cable jack and does not require a separate set-top box. Plug and Play TV owners must obtain a CableCARD from their cable company in order to view scrambled programming services.
HDCP (High-Bandwidth Digital Content Protection)

- HDCP is a specification used to encrypt and protect digital video and audio signals transmitted between two HDCP-enabled devices. HDCP was developed by Intel to provide a way to "lock down" digital signals and protect copyright holders (movie studios, etc.) from having their programs copied and shared. The HDCP standard provides for the secure, encrypted transmission of signals.
PIP (Picture-in-Picture)

• PIP is a feature found in some televisions that lets the viewer to watch one program on the entire screen while displaying a different program in a small window superimposed over the base program.

• Picture-in picture requires two video sources. Some PIP-equipped televisions come with two tuners (one for the PIP window and one for the main program filling the screen), while others rely on an external tuner from another component to supply programming to the picture-in-picture window.

• PIP allows you to watch a particular program while also searching through other channels or content in the PIP window (or vice versa).
Picture-outside-Picture (PoP)

• The dual-tuner design enables images from two sources to be displayed on 16:9 sets simultaneously. Instead of obscuring the main picture by superimposing it as an inset, it uses the extra picture area of the widescreen format to display it alongside the main image. Select models offer a Dual Viewer Split Screen feature that will display two equal-size pictures side-by-side from different channels simultaneously. Hitachi HDTV monitors will also display both standard definition and HD programs simultaneously.
V-Chip

• V-Chip is a feature that allows you to program your TV so that children can’t see certain programs or channels. You can block programs based on violence, sexual content or other content you do not want your children to watch.

• V-chip software reads a code that most broadcasters send with programs. The code contains an age-based rating and content rating (not all programming is rated). You can choose to block those programs with ratings you don’t want your children to see.

• All 13-inch and larger televisions manufactured for the U.S. market since January 1, 2000 are required to have the V-chip technology.
Dolby® Digital

- Formally known as Dolby AC-3
- A 5.1 channel surround sound audio standard for digital television.
SRS® Surround Sound

- A dynamic audio playback system that simulates a three-dimensional sound field using only two speakers. This process works whether the signal is mono, stereo, or surround-encoded.
Types of Digital TVs

- Cathode-Ray Tube (CRT) Direct-View TVs
- Rear Projection TVs (RPTV)
- LCD (Liquid-Crystal Display) TVs
- Plasma TVs
- Front Video Projectors
# Comparison of Display Technology

<table>
<thead>
<tr>
<th>Technology</th>
<th>Shape of Screen</th>
<th>Maximum diagonal Size of Screen</th>
<th>Typical Use</th>
<th>Usable in bright room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eidophor Front Projection</td>
<td>Flat</td>
<td>(limited only by brightness)</td>
<td>TV</td>
<td>no</td>
</tr>
<tr>
<td>Shadow mask CRT</td>
<td>Spherical curve or flat</td>
<td>36 inches</td>
<td>Computer monitor, TV</td>
<td>yes</td>
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<tr>
<td>Aperture grille CRT</td>
<td>Cylindrical curve or flat</td>
<td>36 inches</td>
<td>Computer monitor, TV</td>
<td>yes</td>
</tr>
<tr>
<td>CRT Rear Projection</td>
<td>Flat lenticular</td>
<td>65&quot;</td>
<td>TV</td>
<td>yes</td>
</tr>
<tr>
<td>CRT Front Projection</td>
<td>Flat</td>
<td>(limited only by brightness)</td>
<td>TV or presentation</td>
<td>no</td>
</tr>
<tr>
<td>Plasma</td>
<td>Flat</td>
<td>62&quot; typical as of 2005</td>
<td>TV</td>
<td>yes</td>
</tr>
<tr>
<td>Direct View LCD</td>
<td>Flat</td>
<td>55&quot;</td>
<td>Computer monitor, TV</td>
<td>yes</td>
</tr>
<tr>
<td>LCD Rear Projection</td>
<td>Flat lenticular</td>
<td>65&quot;</td>
<td>TV</td>
<td>yes</td>
</tr>
<tr>
<td>LCD Front Projection</td>
<td>Flat</td>
<td>(limited only by brightness)</td>
<td>TV or presentation</td>
<td>no</td>
</tr>
<tr>
<td>DLP Rear Projection</td>
<td>Flat lenticular</td>
<td>65&quot;</td>
<td>TV</td>
<td>yes</td>
</tr>
<tr>
<td>DLP Front Projection</td>
<td>Flat</td>
<td>(limited only by brightness)</td>
<td>TV or presentation</td>
<td>yes</td>
</tr>
</tbody>
</table>
Plasma Display

- A plasma display is an emissive flat panel display where light is created by phosphors excited by a plasma discharge between two flat panels of glass. The gas discharge contains no mercury (contrary to the backlights of an AMLCD); a mixture of noble gases (neon and xenon) is used instead. This gas mixture is inert and entirely non-harmful.
How Plasma Works

• Plasma is a flat, lightweight surface covered with millions of tiny glass bubbles. Each bubble contains a gas-like substance, the plasma, and has a phosphor coating. Think of the bubbles as the pixels.

• Now, think of each pixel-bubble as having three sub-pixels - one red, one green, one blue. When it is time to display an image signal (RGB or video), a digitally controlled electric current flows through the flat screen, causing the plasma inside designated bubbles to give off ultraviolet rays. This light in turn causes the phosphor coatings to glow the appropriate color.

• Millions of RGB bubbles glow and dim to make a rich, vivid image on your plasma TV.
Why Plasma TV Monitors are Better?

- Higher resolution
- No scan lines
- Exceptional color accuracy
- Widescreen aspect ratio
- Perfectly flat screen
- Uniform screen brightness
- Slim, space-saving design
- Wide viewing angle
- Universal display capability
- Immunity from magnetic fields
## Plasma TV vs. LCD TV

<table>
<thead>
<tr>
<th>Feature</th>
<th>Plasma</th>
<th>LCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Fidelity</td>
<td>Better</td>
<td>Good</td>
</tr>
<tr>
<td>Brightness</td>
<td>Better</td>
<td>Good</td>
</tr>
<tr>
<td>Contrast Ratio</td>
<td>Better</td>
<td>Good</td>
</tr>
<tr>
<td>Color Saturation</td>
<td>Better</td>
<td>Good</td>
</tr>
<tr>
<td>Response Time</td>
<td>Better</td>
<td>Good (16 ms)</td>
</tr>
<tr>
<td>Viewing Angle</td>
<td>160°</td>
<td>100° ~ 170°</td>
</tr>
<tr>
<td>Lifespan</td>
<td>30k ~ 60k hours</td>
<td>50k ~ 75k hours</td>
</tr>
<tr>
<td>Burn In</td>
<td>Good</td>
<td>Better</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>2x</td>
<td>Better (1/2 power)</td>
</tr>
<tr>
<td>Weight</td>
<td>Heavier</td>
<td>Lighter</td>
</tr>
<tr>
<td>Screen Size</td>
<td>37&quot; ~ 71&quot;</td>
<td>~ 45&quot;</td>
</tr>
<tr>
<td>Price per inch</td>
<td>Cheaper</td>
<td>Expensive</td>
</tr>
</tbody>
</table>

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Tuner

• A tuner is an electronic device used to receive and decode signals that can be played on video and audio systems. Tuners are primarily used for television and radio reception.

• Televisions are video displays with tuners built in. Television tuners receive video signals from terrestrial, cable, or satellite sources and transmit them to a video display for viewing.
Set-Top Box (STB)

- A device that receives and converts signals for display on a television screen or monitor (can be digital or analog).
- Also known as a receiver or tuner.
Four Types of TV Set (1)

- Analog TV sets
- **Digital-ready sets** - They should be called EDTV sets. These TVs are normally 480p displays with an analog tuner (for the normal channels 2 through 83) built in. The problem with these sets is that their maximum resolution is the low 480p ED resolution, which eliminates the HD resolutions and makes the TV essentially useless in the future if you plan to watch HDTV programs.
Four Types of TV Set (2)

- **HDTV-ready sets** - These sets are essentially computer monitors able to display 720p or 1080i/p resolution in the 16:9 aspect ratio. They may or may not have analog tuners built in.

- **Integrated HDTV sets** - These sets have a digital tuner for broadcast DTV signals integrated into an HDTV display. With the standards changing so much, you may end up paying for an integrated tuner that becomes obsolete.
Global DTV shipment forecast by display technology

Global large-size panel forecast by application

Source: iSuppli, compiled by DigiTimes, May 2005.