

# **DTV Is Your Friend! (And more...)**

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## **What is Digital Television (DTV)?**

DTV is a digital television transmission system that was created for use by over-the-air broadcasters. A US national voluntary standards body, the Advanced Television Systems Committee (ATSC), created the group of standards for this next generation of television delivery. This new transmission system differs from our current analog NTSC TV system in that it transmits picture and audio as well as “metadata” and other services digitally and can provide various picture quality levels up to High Definition TV, as well as 5.1 channels of surround audio and can offer multiple programs on one signal. Rather than broadcast a single image resolution as the current NTSC system does, ATSC allows the transmission of up to 18 different technical encoding formats. The resulting quality ranges from the resolution of our current television system, through to “movie quality” high definition television images. Should a broadcaster choose to transmit lower resolutions, the station can transmit several programs in the allotted transmission spectrum of 6 MHz. A viewer’s ATSC television receiver is capable of automatically adjusting and displaying the resolution and format of whatever the broadcaster is transmitting. The current analog NTSC transmitters will be shut down on 02/17/2009 (if Congress does not create any delays for this transition). Any TV that currently receives an over-the air analog NTSC signal will no longer see any stations. A set-top or cable box can then be used in front of one of these sets, or a new DTV set can be purchased now or after the transition. Below are some terms and definitions to help you understand the new medium.

### **HDTV**

High-Definition Television (HDTV): The best quality digital picture, widescreen (16 x 9) display with at least 720 progressively scanned lines (720p) or 1080 interlaced lines (1080i) and Dolby digital surround sound. HDTV provides 900,000-2.1 million pixels. Today most broadcasters use the 1080i or 480p format. HD Sets will display this logo:



### **1080p (used by some game machines and DVD players)**

One thousand eighty progressive lines. Not an ATSC standard and not broadcast by any TV station.

### **1080i (used by CBS, NBC, etc)**

One thousand eighty interlaced lines. Movie resolution Interlaced is a way to scan vertical lines onto a TV picture by scanning all the odd lines first, then filling in the even lines.

### **720p (used by ABC and Fox)**

Progressive Scan using 720 lines. A way to scan vertical lines onto a TV picture by scanning all the lines consecutively (progressively). Good for sports due to less motion blurring.

### **480p**

Progressive Scan using 480 lines. A way to scan vertical lines onto a TV picture by scanning all the lines consecutively (progressively). Similar to computer VGA screens.

### **EDTV (being used less)**

Enhanced Definition TV (EDTV): A Better digital television transmission than SDTV with at least 480p, in a 16 x 9 or 4 x 3 display and Dolby digital surround sound. 480p is the quality used by most DVD players.

Many lower end DTV sets incorporate a 480P display. EDTV provides 300-400,000 pixels. ED Sets will display this logo:



### **SDTV**

Standard Definition TV (SDTV): Basic digital television transmission that may be displayed with fewer than 480 progressively scanned lines (480p) in 4 x 3 format or 16x9. 480 interlaced (480i) is the quality of today's analog TV system. SDTV provides 150-300,000 pixels. The aspect ratio is the same as our current analog NTSC. SD Sets will display this logo:



### **Multicasting**

Airing multiple programs on one channel. WGBX-TV, WGBH-TV and WPBX-TV provide more than one program on a TV signal. WHDH-TV provides NBC Weather Plus weather forecasting on its channel 7.2.

### **Aspect Ratio**

The relationship of width to height of a traditional TV screen is 4:3: This numerical sequence refers to the aspect ratio of the National Television Systems Committee (NTSC) TV screen, with "4" unit width corresponding to "3" unit height, proportionally. 16:9 is the aspect ratio of wide screen DTV formats for all HDTV and some SDTV (Standard Definition) video. A "16" unit width corresponds to "9" unit height proportionally. The widescreen 16:9 numerical sequence provides a viewing experience very similar to that of 35 mm movies.

### **Upconverting**

A process by which a standard definition picture is changed or "upconverted" to a simulated high-definition picture. Not real HDTV resolution.

### **ATSC standard A53**

The basic DTV signal standards document that all broadcasters and TV set manufacturers adhere to. This allows set manufacturers to design a TV that is guaranteed to properly decode an over-the air DTV signal.

### **MPEG-2 Video Compression**

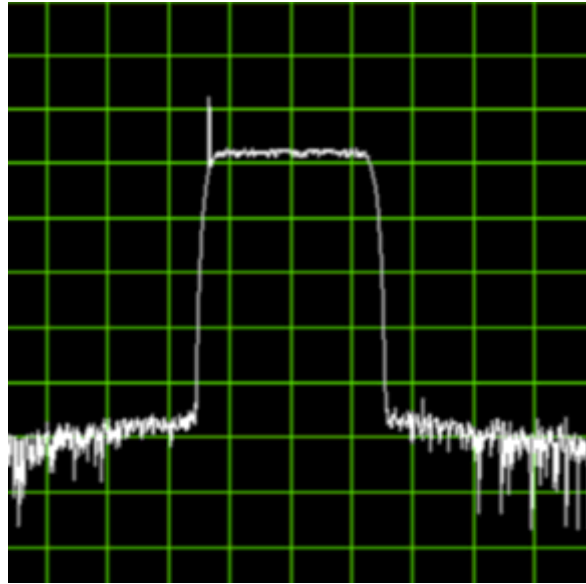
Designed to reduce the data rate that video uses (Mpeg-4 and 7 being slowly implemented). MPEG compression is an internal video compression used within the ATSC standard. Also used for DVD's, DirecTV, etc. Tradeoffs are artifacts such as DCT blocking and motion blurring artifacts.

### **AC-3 Audio**

Dolby 5.1 audio within the ATSC DTV standard and on DVD's. This can provide 5.1 channels (Front left, front right, center, as well as rear left and rear right speaker feeds as well as a sub bass channel) of audio using data compression at up to 384kb/s. Also a wider dynamic range is provided than on analog TV. Sometimes there are problems in broadcasters managing the audio levels of commercials and programs resulting in your having to lower the volume on your TV on certain commercials and segments of a TV program.

### **8VSB**

The signal transmission standard that broadcasters use for over the air RF transmission. The ATSC signal is encoded into a 6 MHz digital RF format for transmitting over the air. This allows for good multipath and other signal path correction. Similar to PSK-31, but far more extensive and robust. Below is an image of an 8VSB television signal.



*An 8VSB RF signal.  
Note the carrier on the top left  
and the sharp out of channel attenuation  
(Image from <http://www.8vsb.com/>)*

### **PSIP**

Metadata added to a TV signal called “Program and System Information Protocol”. When you tune into a DTV “channel” your TV first locks to and reads this “metadata” information to figure out how and where to decode picture (mpeg-2), sound (ac-3), channel branding (MGT, VCT), captioning, program rating (RRT), program guide, and other information. If this is created incorrectly by the broadcaster at worst your TV will not lock to a channel.

### **When**

At midnight on 02/17/2009, all US TV stations (except for LPTV stations) will just turn off their old analog transmitters. All US broadcasters are already transmitting a digital signal and many have been for up to ten years! You can buy a DTV or a converter and watch digital television now. Until the transition to DTV is complete, most television stations will continue broadcasting on both their digital and analog channels. Your current television will work as it does now until analog broadcasting stops. Right now, the FCC is auctioning off the current TV frequencies for such things as public safety communications and wireless internet, etc.

### **How Much?**

\$150.00-4K As usual, prices have come down, and will continue to.

### **Antennas**

While we have become accustomed to watching over the air TV with ghosting and noise, these anomalies will no longer be a visual issue due to the digital transmission medium. However, my experience with over the air DTV reception is that a signal received with multipath reflections is very hard for the DTV tuner to decode. For this reason, I suggest an external TV antenna (any VHF/UHF unit will do) with a rotor to provide the best results. Rabbit ears work well in many instances, but you may not be able to receive all the stations you did in the ‘ol analog days.

## **Connections**

Most accessories (DVD player, CATV box, etc) can be connected with a DHMI cable that contains both the HD video and multichannel audio signal. Older DVD players can be connected via RGB RCA cables. On many sets you can connect your computer using a VGA cable to the TV as well.

## **Television Types:**

### **LCD**

LCD technology is based on the properties of polarized light. Two thin, polarized panels sandwich a thin liquid-crystal gel that is divided into individual pixels. An X/Y grid of wires allows each pixel in the array to be activated individually. When an LCD pixel darkens, it polarizes at 90 degrees to the sandwiching polarizing screens. This cross-polarizing blocks light from passing through the LCD screen where that pixel has darkened. The pixel darkens in proportion to the voltage applied to it: For a bright detail, a low voltage is applied to the pixel; for a dark shadow area, a higher voltage is applied. LCDs aren't completely opaque to light, however; some light will always penetrate even the blackest LCD pixels. That LCD pixels are incapable of blocking all light might seem a fatal flaw. LCD TVs last for up to 60,000 hours and possibly longer if bulb replacement is an option. LCD's do "burn in" on very strong images and have a slower response time as well as a different color response when compared to the old picture tube. The latest LCD technology is OLED (Organic Light Emitting Diode), which eliminates the rear florescent lighting and can provide a very high contrast ratio in a very thin package. These are expensive today (Sony's XEL-1 is at \$2,499.00 for an 11 inch set).

### **Plasma**

Plasma television technology is based loosely on the fluorescent light bulb. The display itself consists of cells. Within each cell two glass panels are separated by a narrow gap in which neon-xenon gas is injected and sealed in plasma form during the manufacturing process. The gas is electrically charged at specific intervals when the Plasma set is in use. The charged gas then strikes red, green, and blue phosphors, thus creating a television image. Each group of red, green, and blue phosphors is called a pixel (picture element). A plasma television has a half-life of about 60,000 to 120,000 hours. This means that it will lose approximately 50% of its brightness during that time. If your Plasma television is on for 8 hours a day, its half-life would be about 9 years. Plasma TV's consume more power than LCD TV's.

### **DLP**

Rear-projection DLP television displays are based on a proprietary semiconductor technology developed by Texas Instruments-the Digital Micro-mirror Device (DMD). This chip contains an array of thousands of microscopic mirrors with widths less than that of a human hair. Each micro-mirror rests on a hinge, which articulates it 10° back and forth on its axis. This allows the micro-mirrors to modulate light by either reflecting it through a color wheel, a projection lens, and, finally, on to a screen, or by deflecting it onto a light absorber. Each micro-mirror is responsible for mapping one pixel, so the number of micro-mirrors in a DLP TV display is equal to its resolution (e.g., 1024x768= 786,432 pixels or 786,432 micro-mirrors). A DLP-based HDTV set should last indefinitely because the digital micro-mirror device behind it is very reliable. There is no maintenance or alignment required for DLP based sets as they age. The only consumer replaceable component is the DLP light source (lamp) which will last for 8,000 hours and costs around \$250 to replace. The micro-mirrors used in DLP are not subject to degradation due to heat, humidity, vibration or "burn-in".

### **Projection**

There are several different display types with different picture quality and lens life; LCD, DLP and CRT are the most common. Cathode Ray Tube (CRT): CRT projectors deliver a high degree of illumination and can project high-resolution video and data at up to workstation frequencies.

### **Set-top Converter Box**

This unit sits on top of the viewer's analog TV, receives the ATSC Digital TV signal from an antenna, converts it to an analog video signal (either NTSC or modulated RF on channel 3 or 4), and then sends that signal on to the analog TV. The government has a converter box coupon program where one can save \$40.00 in buying a set-top box. Between Jan. 1, 2008, and March 31, 2009, all U.S. households will be eligible to request up to two coupons, worth \$40 each, to be used toward the purchase of up to two, digital-to-analog converter boxes. See <https://www.dtv2009.gov/> to register for up to 2 coupons per household. I have had good success with the Zenith unit.

### **PC USB tuners:**

These little units have an F-antenna connector on one end and a USB connector on the other end and display the TV image on your computer screen. They sell for \$40.00-\$120.00 and need a fast computer to use. Look for DVICO's FusionHDTV5 USB Gold, the AutumnWave OnAirGT tuner and the Pinnacle HD Stick Pro.

### **IPTV**

Much video can be viewed via Internet Protocol TV on your home PC, or even your cell phone. This trend will continue as internet data rates increase. I forecast that sometime down the road (say in 20 years), over the air TV will disappear and IPTV will be the replacement. We'll see....

### **Some DTV stations Boston, MA**

<u>Call</u>	<u>Analog</u>	<u>Digital</u>
WGBH	2	19
WBZ	4	30
WCVB	5	20
WHDH	7	42
WFXT	25	31
WSBK	38	39
WGBX	44	43
WLVI	56	41
WUTF	66	23

### **Web resources**

<https://www.dtv2009.gov/> (converter box coupon info for consumers)

<http://www.dtv.gov/> (government info for consumers)

<http://www.atsc.org/> (standard is called A/53 parts 1-6)

<http://www.8vsb.com/> (detailed explanation of the RF format)

<http://www.antennaweb.org/aw/welcome.aspx> (how to obtain and use a DTV antenna)

[http://en.wikipedia.org/wiki/ATSC\\_Standards](http://en.wikipedia.org/wiki/ATSC_Standards)

<http://www.hdtvprimer.com/> (good technical overview)

<http://www.mpeg.org/MPEG/starting-points.html> (the video compression used in ATSC, DVD's, etc)

[http://www.dolby.com/professional/pro\\_audio\\_engineering/index.html](http://www.dolby.com/professional/pro_audio_engineering/index.html) (AC/3 5.1 audio)

<http://www.transmitter.com/dtvref.html> (Doug Lung's DTV transmitter reference page)

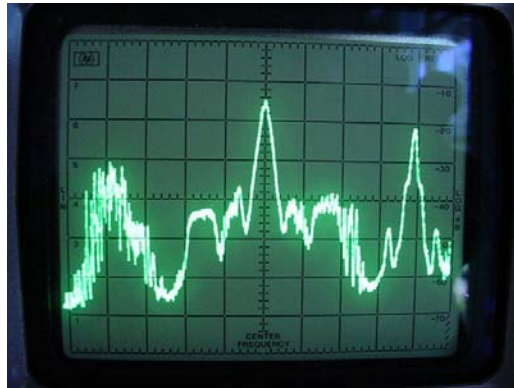
<http://www.pbs.org/digitaltv/> (PBS has good info)

<http://www.avsforum.com/avs-vb/> (consumer hobbyist board)

# Digital Radio

## IBOC Radio

In Band-On Channel (also called “HD Radio”) is a digital radio technical format created by Ibiqity Digital Corporation and is now a National Radio Systems Committee NRSC-5 standard. Here, a digital signal is added to the sidebands of an AM or FM analog signal within the channel limits.



*An IBOC signal on the sides of an analog radio station signal  
(Image from <http://www.ham-radio.com/k6sti/iboc.htm>)*

This service uses the HDC compression system to provide “Near CD” quality (I disagree with the phrase “HD” as the true bit rate is pretty low compared to that of a CD player). If the hybrid analog/digital receiver can no longer decode the digital signal without producing unacceptable errors, the system defaults to the analog mode. AM service after dark has just been started. AM-BCB DX’ers often complain about adjacent channel interference from the IBOC sidebands. In IBOC the AM analog fidelity (bandwidth) is downgraded from 10kc to 5kc when digital signals are being transmitted. This helps make room for the digital components. Radios are starting at the \$60.00 mark.

## Web resources

<http://www.ibiquity.com/technology/papers.htm>

<http://www.rwonline.com/reference-room/iboc/index.shtml>

## DRM

Digital Radio Mondiale. A digital radio standard in use by a few shortwave broadcasters. Uses AAC audio compression and OFDM modulation. 10kc RF bandwidth. RCI, DW, HCJB, Radio France, Radio Netherland. WinRadio, Sangean, homebrew converter and PC.

<http://www.drm.org/>

## HamDream

Digital Radio over ham radio. Adapted from DRM. 2.4kc RF bandwidth.

<http://groups.yahoo.com/group/HamDream24/>

<http://www.qslnet.de/member/hb9tlk/>

[http://sourceforge.net/project/showfiles.php?group\\_id=71084](http://sourceforge.net/project/showfiles.php?group_id=71084)

<http://www.tu-darmstadt.de/fb/et/uet/fguet/mitarbeiter/vf/DRM/DRM.html>

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