Digital television:

See also: Digital terrestrial television

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<td><strong>DVB standards</strong> <em>(countries)</em></td>
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<td>• DVB-T (terrestrial)</td>
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<td>• DVB-C (cable)</td>
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<td>• DVB-H (handheld)</td>
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<td>• DVB-SH (satellite)</td>
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<tr>
<th><strong>ATSC standards</strong> <em>(countries)</em></th>
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</table>
- ATSC (terrestrial/cable)
  - ATSC 2.0
- ATSC-M/H (mobile/handheld)

**ISDB standards (countries)**
- ISDB-T (terrestrial)
  - ISDB-T International SBTVD/ISDB-Tb (Brazil)
- ISDB-S (satellite)
- ISDB-C (cable)
- 1seg (handheld)

**DTMB standards (countries)**
- DTMB (terrestrial)
- CMMB (handheld)

**DMB standard (countries)**
- T-DMB (terrestrial)
- **S-DMB (satellite)**

**Codecs**

- **Video**
  - H.262/MPEG-2 Part 2
  - H.264/MPEG-4 AVC
  - AVS
- **Audio**
  - MP2
  - MP3
  - AC-3
  - AAC
  - HE-AAC

**Frequency bands**

- VHF
- UHF
- SHF
Digital television (DTV) is the transmission of audio and video by digitally processed and multiplexed signal, in contrast to the totally analog and channel separated signals used by analog television. It is an innovative service that represents a significant evolution in television technology since color television in the 1950s. Many countries are replacing broadcast analog television with digital television and allowing other uses of the television radio spectrum. Several regions of the world are in different stages of adaptation and are implementing different broadcasting standards. There are four different widely used digital television terrestrial broadcasting standards (DTTB):

- Advanced Television System Committee (ATSC) uses eight-level vestigial sideband (8VSB) for terrestrial broadcasting. This standard has been adopted in six countries, United States, Canada, Mexico, South Korea, Dominican Republic and Honduras.
- Digital Video Broadcasting-Terrestrial (DVB-T) uses coded orthogonal frequency-division multiplexing (OFDM) modulation and supports hierarchical transmission. This standard has been adapted in Europe, Australia and New Zealand.
- Terrestrial Integrated Services Digital Broadcasting (ISDB-T) is a system designed to provide good reception to fix receivers and also portable or mobile receivers. It utilizes OFDM and two-dimensional interleaving. It supports hierarchical transmission of up to three layers and uses MPEG-2 video and Advanced Audio Coding. This standard has been adopted in Japan, Philippines. ISDB-T International is an adaptation of this standard using H.264/MPEG-4 AVC that been adopted in most of South America and is also being embraced by Portuguese-speaking African countries.
- Digital Terrestrial Multimedia Broadcasting (DTMB) adopts time-domain synchronous (TDS) OFDM technology with a pseudo-random signal frame to serve as the guard interval (GI) of the OFDM block and the training symbol. The DTMB standard has been adopted in the People's Republic of China, including Hong Kong and Macau.

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Technical information:-

Formats and bandwidth

Digital television supports many different picture formats defined by the broadcast television systems which are a combination of size, aspect ratio (width to height ratio).

With digital terrestrial television (DTV) broadcasting, the range of formats can be broadly divided into two categories: high definition television (HDTV) for the transmission of high-definition video and standard-definition television (SDTV). These terms by themselves are not very precise, and many subtle intermediate cases exist.

Television pictures have differing amounts of definition (rendering of fine detail) according to how many individual picture elements are provided to reconstruct the picture. This definition is expressed as the number of horizontal lines and picture elements (pixels) in each line that are used for different formats. Thus when we say a format is 640 × 480p we mean there are 640 elements in each of 480 horizontal lines (scanned progressively) for a total of 307,200 pixels and an aspect ratio of 640÷480 or 4:3 (4 units wide by 3 units high) or SDTv.

One of several different HDTV formats that can be transmitted over DTV is: 1280 × 720 pixels in progressive scan mode (abbreviated 720p) or 1920 × 1080 pixels in interlaced video mode (1080i). Each of these uses a 16:9 aspect ratio. (Some televisions are capable of receiving an HD resolution of 1920 × 1080 at a 60 Hz progressive scan frame rate — known as 1080p.) HDTV cannot be transmitted over current analog television channels because of channel capacity issues.
Standard definition TV (SDTV), by comparison, may use one of several different formats taking the form of various aspect ratios depending on the technology used in the country of broadcast. For 4:3 aspect-ratio broadcasts, the 640 × 480 format is used in NTSC countries, while 720 × 576 is used in PAL countries. For 16:9 broadcasts, the 720 × 480 format is used in NTSC countries, while 720 × 576 is used in PAL countries. However, broadcasters may choose to reduce these resolutions to save bandwidth (e.g., many DVB-T channels in the United Kingdom use a horizontal resolution of 544 or 704 pixels per line).

Each commercial broadcasting terrestrial television DTV channel in North America is permitted to be broadcast at a bit rate up to 19 megabits per second. However, the broadcaster does not need to use this entire bandwidth for just one broadcast channel. Instead the broadcast can use the channel to include PSIP and can also subdivide across several video sub channels (aka feeds) of varying quality and compression rates, including non-video data casting services that allow one-way high-bandwidth streaming of data to computers like National Data cast.

A broadcaster may opt to use a standard-definition (SDTV) digital signal instead of an HDTV signal, because current convention allows the bandwidth of a DTV channel (or "multiplex") to be subdivided into multiple digital sub channels, (similar to what most FM radio stations offer with HD Radio), providing multiple feeds of entirely different television programming on the same channel. This ability to provide either a single HDTV feed or multiple lower-resolution feeds is often referred to as distributing one's "bit budget" or multicasting. This can sometimes be arranged automatically, using a statistical multiplexer (or "stat-mux"). With some implementations, image resolution may be less directly limited by bandwidth; for example in DVB-T, broadcasters can choose from several different modulation schemes, giving them the option to reduce the transmission bitrate and make reception easier for more distant or mobile viewers.

Reception

There are a number of different ways to receive digital television. One of the oldest means of receiving DTV (and TV in general) is using an antenna (known as an aerial in some countries). This way is known as Digital terrestrial television (DTT). With DTT, viewers are limited to whatever channels the antenna picks up. Signal quality will also vary.

Other ways have been devised to receive digital television. Among the most familiar to people are digital cable and digital satellite. In some countries where transmissions of TV signals are normally achieved by microwaves, digital MMDS is used. Other standards, such as Digital multimedia broadcasting (DMB) and DVB-H, have been devised to allow handheld devices such as mobile phones to receive TV signals. Another way is IPTV, that is receiving TV via Internet Protocol, relying on Digital Subscriber Line (DSL) or optical cable line. Finally, an alternative way is to receive digital TV signals via the open Internet. For example, there is P2P (peer-to-peer) Internet television software that can be used to watch TV on a computer.
Some signals carry encryption and specify use conditions (such as "may not be recorded" or "may not be viewed on displays larger than 1 m in diagonal measure") backed up with the force of law under the WIPO Copyright Treaty and national legislation implementing it, such as the U.S. Digital Millennium Copyright Act. Access to encrypted channels can be controlled by a removable smart card, for example via the Common Interface (DVB-CI) standard for Europe and via Point Of Deployment (POD) for IS or named differently Cable Card.

Protection parameters for terrestrial DTV broadcasting

[citation needed]

Digital television signals must not interfere with each other, and they must also coexist with analog television until it is phased out. The following table gives allowable signal-to-noise and signal-to-interference ratios for various interference scenarios. This table is a crucial regulatory tool for controlling the placement and power levels of stations. Digital TV is more tolerant of interference than analog TV, and this is the reason a smaller range of channels can carry an all-digital set of television stations. [citation needed]

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<tbody>
<tr>
<td>C/N for AWGN Channel</td>
<td>+19.5 dB (16.5 dB)</td>
<td>+15.19 dB</td>
<td>+19.3 dB</td>
<td>+19.2 dB</td>
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<tr>
<td>Co-Channel DTV into Analog TV</td>
<td>+33.8 dB</td>
<td>+34.44 dB</td>
<td>+34 ~ 37 dB</td>
<td>+38 dB</td>
</tr>
<tr>
<td>Co-Channel Analog TV into DTV</td>
<td>+7.2 dB</td>
<td>+1.81 dB</td>
<td>+4 dB</td>
<td>+4 dB</td>
</tr>
<tr>
<td>Co-Channel DTV into DTV</td>
<td>+19.5 dB (16.5 dB)</td>
<td>+15.27 dB</td>
<td>+19 dB</td>
<td>+19 dB</td>
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<tr>
<td>Lower Adjacent Channel DTV into Analog TV</td>
<td>−16 dB</td>
<td>−17.43 dB</td>
<td>−5 ~ −11 dB</td>
<td>−6 dB</td>
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<td>Upper Adjacent Channel DTV into Analog TV</td>
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<td>−11.95 dB</td>
<td>−1 ~ −10</td>
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<td>Lower Adjacent Channel Analog TV into DTV</td>
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<td>−34 ~ −37 dB</td>
<td>−35 dB</td>
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<tr>
<td>Upper Adjacent Channel Analog TV into DTV</td>
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<td>Lower Adjacent Channel DTV into DTV</td>
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<td>−28 dB</td>
<td>−30 dB</td>
<td>−28 dB</td>
</tr>
<tr>
<td>Upper Adjacent Channel DTV into DTV</td>
<td>−27 dB</td>
<td>−26 dB</td>
<td>−30 dB</td>
<td>−29 dB</td>
</tr>
</tbody>
</table>
Interaction

Humans can interact with a DTV system in various ways. One can, for example, browse the Electronic program guide.

Modern DTV systems sometimes use a return path providing feedback from the end user to the broadcaster. This is possible with a coaxial or fiber optic cable, a dialup modem, or Internet connection but is not possible with a standard antenna.

Some of these systems support video on demand using a communication channel localized to a neighborhood rather than a city (terrestrial) or an even larger area (satellite).

1-segment broadcasting

1seg (1-segment) is a special form of ISDB. Each channel is further divided into 13 segments. The 12 segments of them are allocated for HDTV and remaining segment, the 13th, is used for narrowband receivers such as mobile television or cell phone.

Main article: 1seg

Comparison analog vs digital

Further information: Analog television

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DTV has several advantages over analog TV, the most significant being that digital channels take up less bandwidth, and the bandwidth needs are continuously variable, at a corresponding reduction in image quality depending on the level of compression as well as the resolution of the transmitted image. This means that digital broadcasters can provide more digital channels in the same space, provide high-definition television service, or provide other non-television services such as multimedia or interactivity. DTV also permits special services such as multiplexing (more than one program on the same channel), electronic program guides and additional languages (spoken or subtitled). The sale of non-television services may provide an additional revenue source.
Digital and analog signals react differently to interference. For example, common problems with analog television include ghosting of images, noise from weak signals, and many other potential problems which degrade the quality of the image and sound, although the program material may still be watchable. With digital television, the audio and video must be synchronized digitally, so reception of the digital signal must be very nearly complete; otherwise, neither audio nor video will be usable. Short of this complete failure, "blocky" video is seen when the digital signal experiences interference.

Analog TV started off with monophonic sound, and later evolved to stereophonic sound with two independent audio signal channels. DTV will allow up to 5 audio signal channels plus a subwoofer bass channel, with broadcasts similar in quality to movie theaters and DVDs.

Effect on existing analog technology

Television sets with only analog tuners cannot decode digital transmissions. When analog broadcasting over the air ceases, users of sets with analog-only tuners may use other sources of programming (e.g. cable, recorded media) or may purchase set-top converter boxes to tune in the digital signals. In the United States, a government-sponsored coupon was available to offset the cost of an external converter box. Analog switch-off (of full-power stations) took place on December 11, 2006 in The Netherlands, June 12, 2009 in the United States, July 24, 2011 in Japan, August 31, 2011 in Canada, February 13, 2012 in Arab states, May 1, 2012 in Germany, October 24, 2012 in the United Kingdom and Ireland, October 31, 2012 in selected Indian cities, and December 10, 2013 in Australia. Completion of analog switch-off is scheduled for December 31, 2014 in the whole of India, by 2015 in the Philippines and Uruguay, and by 2017 in Costa Rica.

Disappearance of TV-audio receivers

Prior to the conversion to digital TV, analog television broadcast audio for TV channels on a separate FM carrier frequency from the video signal. This FM audio signal could be heard using standard radios equipped with the appropriate tuning circuits.

However, after the relatively recent transition of many countries to digital TV, no portable radio manufacturer has yet developed an alternative method for portable radios to play just the audio signal of digital TV channels. (DTV radio is not the same thing.)

Environmental issues

The adoption of a broadcast standard incompatible with existing analog receivers has created the problem of large numbers of analog receivers being discarded during digital television transition. One superintendent of Public Works was quoted in 2009 as saying, "Some of the studies I’ve read in the trade magazines say up to a quarter of American households could be throwing a TV out in the next two years following the
regulation change”. In 2009, an estimated 99 million analog TV receivers were sitting unused in homes in the US alone and, while some obsolete receivers are being retrofitted with converters, many more are simply dumped in landfills where they represent a source of toxic metals such as lead as well as lesser amounts of materials such as barium, cadmium and chromium.

According to one campaign group, a CRT computer monitor or TV contains an average of 8 pounds (3.6 kg) of lead. According to another source, the lead in glass of a CRT varies from 1.08 lb to 11.28 lb, depending on screen size and type, but the lead is in the form of "stable and immobile" lead oxide mixed into the glass. It is claimed that the lead can have long-term negative effects on the environment if dumped as landfill. However, the glass envelope can be recycled at suitably equipped facilities. Other portions of the receiver may be subject to disposal as hazardous material.

Local restrictions on disposal of these materials vary widely; in some cases second-hand stores have refused to accept working color television receivers for resale due to the increasing costs of disposing of unsold TVs. Those thrift stores which are still accepting donated TVs have reported significant increases in good-condition working used television receivers abandoned by viewers who often expect them not to work after digital transition.

In Michigan in 2009, one recycler estimated that as many as one household in four would dispose of or recycle a TV set in the following year. The digital television transition, migration to high-definition television receivers and the replacement of CRTs with flat screens are all factors in the increasing number of discarded analog CRT-based television receivers.

**Technical limitations**

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**Compression artifacts and allocated bandwidth**

DTV images have some picture defects that are not present on analog television or motion picture cinema, because of present-day limitations of bandwidth and compression algorithms such as MPEG-2. This defect is sometimes referred to as "mosquito noise".
Because of the way the human visual system works, defects in an image that are localized to particular features of the image or that come and go are more perceptible than defects that are uniform and constant. However, the DTV system is designed to take advantage of other limitations of the human visual system to help mask these flaws, e.g., by allowing more compression artifacts during fast motion where the eye cannot track and resolve them as easily and, conversely, minimizing artifacts in still backgrounds that may be closely examined in a scene (since time allows).

**Effects of poor reception**

Changes in signal reception from factors such as degrading antenna connections or changing weather conditions may gradually reduce the quality of analog TV. The nature of digital TV results in a perfectly decodable video initially, until the receiving equipment starts picking up interference that overpowers the desired signal or if the signal is too weak to decode. Some equipment will show a garbled picture with significant damage, while other devices may go directly from perfectly decodable video to no video at all or lock up. This phenomenon is known as the digital cliff effect.

For remote locations, distant channels that, as analog signals, were previously usable in a snowy and degraded state may, as digital signals, be perfectly decodable or may become completely unavailable. The use of higher frequencies will add to these problems, especially in cases where a clear line-of-sight from the receiving antenna to the transmitter is not available.