

Assisting the Public with the Transition to Digital Broadcast Television

Bob Allison, WB1GCM, ARRL Test Engineer

As we all have heard, Digital Broadcast Television is here. Our old analog TV sets will get nothing but snow and noise after June 12th, 2009, unless it has a converter box between the antenna and TV. Many Hams have taken the opportunity to assist their fellow neighbors by giving talks on the digital conversion to local civic groups. Good Job!

The place to go for nearly all of the questions the public might ask can be answered by the Government's website, <http://dtv.gov/consumercorner.html>. I listed some of the most asked questions that our public is concerned with. Afterwards, I will give some technical facts and links of what channels are available according to the street address to each viewer and what kind of antenna they would need to continue watching "Off-Air" television.

SOME FAQ

What is the digital TV (DTV) transition?

The switch from analog to digital broadcast television is referred to as the digital TV (DTV) transition. In 1996, the U.S. Congress authorized the distribution of an additional broadcast channel to each broadcast TV station so that they could start a digital broadcast channel while simultaneously continuing their analog broadcast channel. Originally set for February 17, 2009, Congress pushed the transition date up to June 12, 2009 as the final date that full-power television stations must broadcast in digital only. Some local stations may shut down their analog transmitters before then; one quarter of broadcast stations are pulling the plug on February 17th.

Cable and satellite TV subscribers with analog TVs hooked up to their cable or satellite service should not be affected by the transition to full-power analog broadcasting.

Why the switch to DTV?

The switch to all digital broadcasting will free up valuable spectrum space. This spectrum space was auctioned off to companies that will provide advanced wireless services such as mobile television service. A benefit to everyone is at UHF frequencies, there will be a need for fewer cell towers since greater distances can be covered. Besides wireless companies, spectrum space has been set aside for public safety.

Digital Television can fit up to four channels in the same spectrum space as one analog channel. This gives the off-air viewer the potential for more channels to watch, using a process called "multicasting". Broadcasters can use the whole channel allocation for one high definition (HD) channel, or the multicasting of four standard definition (SD) channels. Even SD channels are an improvement in picture quality over analog channels with no snow or ghosting. Broadcasters use much less electricity to transmit programs to your homes, while providing more programming.

What do I need to do to be ready for the end of analog TV broadcasting?

By June 12, 2009, all over-the-air TV broadcasts will be in digital. If you have a television that receives off-air television programming, with a roof-top antenna or "rabbit ears", the type of TV you own is very important. A TV with an internal digital tuner will allow you to continue to watch off-air programming. If you have an analog TV, you'll need a digital-to-analog converter box to continue to watch off-air television. Don't wait until the last day. Many stations may be converting entirely over to digital; some as early as February 17th, 2009.

Why Do I Have to Pay for the Converter?

The good news is, the Government will pay for most of it by giving each household up to two \$40 coupons to go defray the cost of the converter. Apply for coupons and purchase and hookup your digital to analog converter box. Converter boxes are available at department stores or on line and on average go for \$40 to \$70. You can only use *one coupon per converter box* and they must be used at the time of purchase. For more information on the Digital-to-Analog Converter Box Coupon Program, visit the NTIA's website at www.dtv2009.gov, or call 1-888-388-2009 (voice) or 1-877-530-2634 (TTY).

If I have an older analog television, will I have to throw it away after June 12, 2009?

A converter box will allow you to continue using your existing analog TV to watch off-air digital broadcasts. You do not need to get rid of your existing analog TV.

Where can I recycle my old TV if I get a new one?

A good question! Check with your town or city to see if they accept televisions for recycling. If not, there are companies that will take them for free if they are dropped off. Shop around, since some charge \$10 to \$15 for a disposal fee. Check out this web site for the proper disposal of your old TV: <http://www.mygreenelectronics.org/home.aspx>
Type in your zip code and you will find the closest places which will accept your old TV for recycling.

Can I hook up more than one TV and video recorder to a single digital-to-analog converter box?

You will need one digital-to-analog converter box for the TV set and one for the VCR or other device that has an analog tuner. The converter box basically replaces the analog tuner in each piece of equipment. If you wish to watch TV and record another channel on your VCR at the same time, you will need two converter boxes.

How do I hook up the converter box?

The converter box is placed in line between the antenna and the "antenna input" of the TV. The coax cable from your antenna is plugged into the "antenna input" connector on the converter box. A short coax cable is supplied with the converter box and is placed from the "to TV" connector on the converter box to the "antenna input" of the TV. Most converter boxes also have audio and video outputs, which is be another option on the hookup.

I have an old antenna that attaches to my TV with two wires. Will I be able to use a converter box with this antenna?

Converter boxes use coax cable for the antenna input and the converter output. If you have flat cable (twin-lead), you will need two adapters, called "baluns" or "matching transformers". But first, check to see if there is a small circular connector (coax) on the back of the set, labeled, "antenna in" or "coax in". If not, unscrew the existing twin-lead antenna wire from your TV twin-lead terminals. Attach the existing twin-lead antenna wire to the twin-lead terminals on the twin-lead adaptor (first picture below). Then plug the twin-lead adaptor's coaxial connector into the "Antenna In (RF)" port on the Converter Box. Using coaxial wire, plug one end into the "Out To TV (RF)" port on the Converter Box. Plug the other end into a coaxial adaptor (second picture below). Then attach the coaxial adaptor to your TV "Antenna In" twin-lead terminals.



My radio currently receives the audio portion of TV channels. Will it work after June 12, 2009?

Radios that are designed to tune the audio portion of analog TV broadcasts will *not* be capable of receiving the audio portion of digital TV broadcasts. You may wish to consider obtaining new portable digital televisions or radios that can receive the audio portion of digital television broadcasts as they become available on the market.

My local AM/FM radio station re-broadcasts a TV channel's audio. Will the radio station continue this service after June 12, 2009?

Actually, all the re-broadcaster needs is an analog tuner (which they already use) and a converter box to get the TV audio to their studio console via the converter's audio output jack. Please check with your local radio AM/FM broadcaster to see if they will maintain TV channel audio re-broadcasting. It shouldn't be a budget buster for them to change over.

What are low-power (LPTV), Class A, and TV translator stations and how does the DTV transition affect them?

You may have noticed that Congress mandated that "full-power" TV stations will not be able to broadcast in analog after June 12, 2009. While the majority of the viewed TV broadcast stations are full-power stations, three other categories of TV stations exist – "low-power" stations, "Class A" stations, and "TV translator" stations. There is currently no deadline for these stations to convert to digital broadcasting.

AND NOW.....SOME TECHNICAL STUFF.

Simply put, Off-Air digital television transmissions are harder to receive than the old analog transmissions. Digital TV transmitters run much less power than their old analog counterparts; in some cases, one tenth the power. You may need a better antenna if you want to see the same station. Many of us have been accustomed to "rabbit ear" or "bow tie" reception with some snow in the picture. If you receive a station's analog picture with some snow, its digital signal will be below the threshold that will give a picture. With digital TV, you either have a picture, or you don't. This is one fact the general public does not realize or is just finding out. Because of multicasting, you may end up with more digital programming to see, but you also may lose a major network if that station does not have a strong enough signal. As someone who has enjoyed DXing TV stations, I am a bit sad to see analog TV go away.

There are several good indoor antennas with preamps built in that will work better than rabbit ears. Some larger ones are very compact and rotate and can fit into attic or eave space. Most of the digital broadcasts are in the UHF television spectrum, making small, high gain TV antennas practical. If this is out of the question, I would recommend at the very minimum, a dual bow tie antenna with a reflector for UHF. I've seen some crafty people make them out of cardboard and aluminum foil.

VHF digital broadcasts have been a disappointment for many people I've talked to. Unless you are close to the TV transmitter, standard rabbit ears will not work well, at all.

For an idea of what reception you'll have and the antenna you will need, there are a couple of good websites I've seen: Go to <http://www.antennaweb.org> Click on "Choose an Antenna" Enter your zip code and uncheck the two boxes. Next, enter the address of who you're helping. Answer the two questions about your terrain and house. Click Submit. Through that you'll be able to figure out digital what television stations are in your area, where they are and what antenna system you'll need.

Another site that predicts coverage and antenna needs is: <http://tvfool.com/>

AND from our website, a very good explanation of how DTV is transmitted by author David Sparano: <http://www.arrl.org/tis/info/DTV-transition.html>

Programming a Converter Box

Digital to Analog converter boxes have both RF output or audio/video output connectors. The box will come with both the short RF cable and the audio/video cables. Some sets have audio/video inputs. The person you are helping may have other accessories, such as a VCR, DVD player, etc. Ask what they have and draw out a wiring diagram for them, if necessary. If, by chance, the set is really a dinosaur and it has only two screw terminals for twin lead, you will need two baluns, as mentioned above.

Once hooked up and turned on, a menu will pop up on the screen. The menu is simple and intuitive. With a press of a couple of buttons, it will automatically search the VHF and UHF spectrum for digital broadcast signals. Before doing so, I would aim the available antenna in the direction of the closest station. After the search is done, you may only get a few channels, depending on distance and terrain from the TV transmitters.

You'll notice as you advance the "channel" button on the converter's remote that stations are labeled Channel 30.1, 30.2, 30.3, 30.4, for example. That station is multicasting four channels, each in standard definition. However, you may have a station that is labeled 24.1 That station is using its entire allowed spectrum to give the viewer a high definition picture. You will notice that the picture on the analog TV is clearer, but by no means is it high definition. As you use the remote, you'll notice that the station number is the station's analog channel number. The screen will say "Channel 30", but the converter box is tuned to Channel 35.

On the remote is a "signal" button. Press it and up pops a handy relative signal strength meter divided into three segments (hey, that's an improvement over my old set!). I've noticed that in general, for a picture to be consistent without locking up, the signal has to read at least one half to two thirds scale. You will need this signal strength meter for the next step.

Once a list of known digital television stations is acquired (from one of the links above), you will need to manually program the converter box for each station, one at a time. After a station is manually entered in to your converter box, you may only get a black or blue picture, meaning "no picture". If so, use the "signal" button to see if there is an indication of a signal. Rotate the antenna and go for the maximum signal strength. You still may not get a picture, or, you get a frozen broken up picture, which goes to black after a bit. If that happens, there's hope, but only if you either install a preamp, a better antenna, or both. That's probably what the viewer you're

helping does not want to hear. If they can't afford basic cable, they will not be able to afford the equipment needed to get all of the same stations they previously watched on their analog tuners. Viewers who have chosen not to have cable TV or other services may have to settle for fewer stations, upgrade their antenna systems, or pay for at least basic cable.

For a really neat listing of DTV stations in your area, check out this excellent link: <http://www.rabbitears.info/market.php> You can check the technical information of each station, such as effective radiated power (ERP), antenna height, antenna pattern, coverage area and the exact location of the antenna. Each "market" in the USA is listed. Don't forget to check out nearby markets for coverage. For instance, I where I live in Coventry, CT, I can receive stations from the Hartford, Providence RI and Springfield, MA markets. With the new UHF Yagi I'm putting up, I hope to get some of the Boston stations too.

I would like to stress one point: A DTV channel assignment for a particular station may change back to their old analog channel assignment. Example: "Channel 20" is analog broadcasting on channel 20 and digital broadcasting on channel 12. After analog transmissions cease, "Channel 20" will be broadcasting digital on channel 20 and not on channel 12. To me, this seems to be the best way to keep the original "Brand" and keeps viewer confusion to a minimum. My point is, please pass along to the viewer you're helping that the channels they have programmed into your converter may move. The rabbit ears site above clearly shows which stations are changing their digital channel assignment. Provide each viewer with the changes mentioned.

Report from the ARRL Lab Regarding Amateur Radio Operation and Converter Boxes....

Gentlemen,

Bob Allison, WB1GCM here at the ARRL Laboratory. Upon receiving an email from a concerned member, I thought I would test out a digital TV to analog TV converter box that one of our Lab staffers had. It is a Zenith brand, identical to an Insignia brand I have at home.

To test the box by itself, I took the RF output from the converter box and fed it directly via coax to the analog TV RF input, using Broadcast channel 3 on the TV (DTV Channel 33).

Fed *directly* to the antenna input of the converter box, I combined an off air digital signal with an analog RF signal typical (representing) for a very strong nearby ham transmitter (CW and Amplitude modulation). Watching and listening to the television, I varied my signal generator's frequency through the MF, HF, VHF and UHF spectrum at 0 dBm, (over 70 dB over S9 on some S meters) with no problems, signal break-up, etc. The TV signal strength meter was typically about 2/3 scale, just enough for the (TV) signal to come in. The test was repeated watching both VHF and UHF DTV channels.

Problems occurred in the +5 dBm range, where you would expect any receiver to have blocking issues. Another Lab staff member and I both concluded the box we tested was very good at rejecting strong signals.

For more fun, W1AW was fired up on 20 meters, with 1.5 kilowatts on SSB, right across the parking lot! This was a good, real life overload test. No break-up or pixilation occurred. Please note our (TV) receiving antenna was a GAP all HF band vertical on the roof of ARRL HQ.

While I can't speak for all converter boxes, TVI from Radio Amateurs is still possible, but not likely through the TV antenna. Many DTV problems occur with RF getting into cables, power lines, etc

and can be solved on an as needed basis, just like with analog TVs...same old problems. The ARRL offers a great RFI Handbook to solve such problems.

Off-air DTV needs a good signal to be seen. Either you have it, or you don't, period. There is no in between like analog. Break-up can happen without any ham radios near by on a good day. However your neighbor may not understand the nature of DTV and may think it's "that ham". As previously, try to be a good neighbor and ambassador of ham radio by offering the placement of filters and advice on how to improve their antenna..

Bob Allison
WB1GCM
ARRL Test Engineer

Note: I have not had any interference *to* Amateur Radio from my converter box at my home.

What Fixed TVI with Analog TVs Still Applies

As concluded in my letter above, the Digital to Analog Converter Box did an excellent job rejecting strong signals and would not cause a TVI situation to get worse. TVI can still occur, though. An excellent guide on how to reduce or eliminate TVI with your neighbor, though only with analog TVs is still useful. From our website:

<http://www.arrl.org/tis/info/tvi.html>

Good Luck and thanks for helping the public with this transition. You have a wonderful opportunity to be an ambassador for Amateur Radio and you just might be *the* "Elmer" someone has been looking for to become a ham.

Bob Allison
WB1GCM
ARRL Test Engineer

Bob Allison served as an engineer and studio supervisor at the NBC owned and operated NBC30, now NBC Connecticut, for 28 years, prior to being Test Engineer at the ARRL Laboratory.