Off-Air Antennas and an Alignment TIP

TR March TIP-of-the-Month

This month's TIP is all about off-air antennas and proper alignment. It includes a little history and current events to get you up to speed on what the latest rule-making from the FCC is all about and how to find out what's happening in your local area. There are some interesting surprises.

History

First I want to refresh your memory on the U.S.'s transition from analog to digital television.

Back in the late 90's, our Congress directed the FCC to orchestrate the transition from an all analog television broadcast system (NTSC) to a new digital system (ATSC). The FCC established a 10 year transition period, ending in 2006, to convert the the system to digital broadcasts and end NTSC analog television.

One of the first things the FCC did was to define a new DTV channel allocation plan. In this plan, all television stations would operate in the UHF range of channel 14-51. VHF channels, as well as UHF channels 52-69 would be reallocated (auctioned off) to new services (to raise money for the treasury- why do you think Congress liked this idea in the first place!). Channels 60-69 were reallocated by 1999 and channels 52-59 were reallocated by 2001 (existing stations in the 52-69 range have until the end of the transition period to move to their new DTV channel). In the meantime, the FCC assigned a new *temporary* UHF channel in the 14-51 range to existing TV broadcast stations to begin DTV service during the transition period. 99.9% of all stations are now using the new channel to broadcast some form of DTV (mostly standard-definition with a few hours of high-definition). [*Little known factoid - there is no channel 37. The frequency range is allocated to radio astronomy use*]

During the transition period, broadcasters selected their ultimate permanent DTV channel through seven rounds of channel elections held by the FCC. Meanwhile, around 2000-2001, based on many complaints from TV station owners and lobby pressure, the FCC reversed itself on spectrum allocation and decided to keep the VHF channels (in fact channels 7-13 are the best DTV channels - see below). Channels 2-13 became part of the "core" DTV channel space. Broadcasters were then allowed to choose any VHF or UHF channel from 2-51 as their permanent DTV channel. Many stations elected to move to an entirely new channel, neither their existing NTSC channel or temporary DTV channel.

Current Events

Well, several things have changed, some you've heard about, some you haven't. As we all know, the end of the transition period (when the lights would be turned off on analog TV) has been extended several times. As of now, the date is February 17, 2009--the FCC's final final "line in the sand".

In October 2006, the final channel selection process was completed (FCC 06-105, Notice of Proposed Rule-making). There appears to be a hand full of conflicts still to be resolved but 99% of stations now have a new permanent channel. The FCC list of permanent channel assignments is available at:

http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-06-1082A2.pdf

Check this list out to see the final channel assignments in your city. If you look closely, you will also notice something interesting. Only a few stations chose to remain on channels 2-6. Essentially this spectrum has been abandoned by broadcasters. Technically, channels 2-6 are the least desirable due to high electrical noise levels and channels 14-51 are subject to problematic multipath interference. It turns out the best channels for DTV are the VHF high-band 7-13. Many stations elected to move to these channels.

Practical Ramifications

So what does all this have to do with the price of beans in China? Well, it means that when you are incorporating off-air service into your installation, you can concentrate on channels 7-51. This means you still have to provide for VHF channels and a corresponding antenna but can optimize that choice for the 7-51 channel range. You can also be fairly certain that the channel assignments in the FCC are set for the foreseeable future.

Until Feb 17, 2009, if your customer is only interested in DTV, 99.9% of DTV broadcasting is in the UHF band (14-51), but between now and Feb 17, 2009 many of these stations will be moving to the VHF 7-13 range.

A few antenna manufacturers have VHF antennas for channel 7-13 and there are excellent small antennas for the 14-51 channel range. A few of my favorites.

VHF only

Antennacraft ch7-13 VHF yagi www.antennacraft.net/Yagi.htm
Winegard HD4053P VHF yagi www.warrenelectronics.com/antennas/hd4053p.htm

UHF only

Antennacraft U1000 www.antennacraft.net/U1000.htm
Winegard PR440 (and PR880) www.hdtvprimer.com/ANTENNAS/w4400.html
Winegard PR9022 www.warrenelectronics.com/antennas/pr9022.htm
Channel Master 4308 www.warrenelectronics.com/antennas/4308.htm

Of course you can combine them if the VHF and UHF stations are in the same direction and there are many excellent combination antennas. Check out Warren Electronics (www.warrenelectronics.com)

Low Cost Antenna Alignment Tool

It was usually acceptable to align an off-air antenna for NTSC analog signals by simply looking at the screen while someone moved the antenna for best picture and minimum "ghosting". Unfortunately, this technique will not work for DTV. The reason is the "cliff" ef-

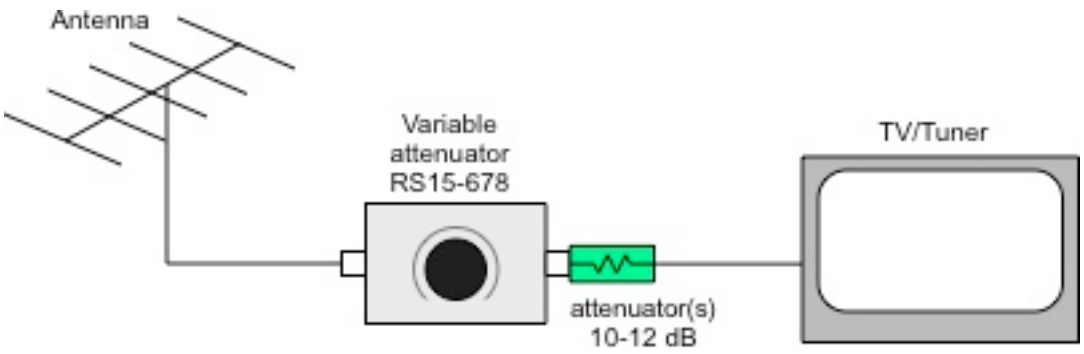
fect of DTV will give a good picture through a wide range of signal levels making it impossible to know the direction for the best signal. You might get a good picture, but be on the "raged edge". The picture might look fine now, but in the next bad weather, wind, snow, or the next moving van that rolls by, the picture starts to drop out, freeze, pixelate, etc.

Normally, to align an antenna correctly you should use a good signal strength meter designed for DTV signals (analog meters are NOT reliable for DTV). You simply point the antenna toward the transmitter for the best signal strength on the meter. You may have to move it to a different location or move it up or down for the best signal.
Unfortunately a good signal strength meter, such as the Sencore SLM1453 costs about a grand. However, with a little ingenuity and a few bucks in parts, you can do a good job without the high priced meter.

Most DTV receivers have a built in on-screen signal strength meter (like satellite receivers). By themselves they are not real accurate. If you live in a city area signal strengths can actually be too high to make the meter too meaningful.

The trick is to purposely lower the signal from the antenna to the receiver until it is on the "ragged edge". Basically you want to simulate tuning in a very distant signal so you only get a good picture when you are "right on". A good picture is defined as one with NO pixilation, dropouts, or freezes. This will take a little patience.

Digital TV's will give an excellent picture down to about -15 dBmV. If you live anywhere near a decent DTV station, the signal strength should be much higher, as much as +15-20 dBmV. Therefore we need to attenuate the received signal by 20-30 dB before it goes to the receiver. The following hookup will do the job:



This uses the old reliable Radio Shack RS15-678 attenuator (they still sell it the last time I checked). This gadget is a variable attenuator with an approximate 20 dB range. If you live in area of strong signals, add a 10 dB attenuator (or two 6 dB attenuators) to the input. These are available from many distributors at low cost, including Radio Shack. Connect this between the antenna and the TV.

What you're trying to do is set the attenuation so that you only get a good picture with the antenna in the best position. BEST may not be directly at the broadcast site, but the direction with the minimum multipath interference.

Point the antenna in the approximate direction of the station and turn the TV (or tuner) to the station. Use the TV/tuner menu to pull up the signal strength meter. Set the variable attenuator full counter-clockwise (minimum attenuation). You should be able to see a good picture. Now increase the attenuation until the picture begins to drop out (no telling what the meter will say but make a note of it). Now have your buddy SLOWLY turn the antenna for the highest meter reading (your doing this via cell phones or two-way radios). Now increase the attenuation until the picture drops out again (if it won't, add in more attenuators). Try fine tuning the antenna for a picture that is solid. If you can't, decrease the attenuation until you get a picture and try again. When you're done, you should have the best direction for THAT STATION. Make a note of the direction (use a compass, or write down what the antenna is pointed at). If other stations are not in exactly the same direction, you need to do the same thing for each station (assuming they are in the same general direction), and then set the antenna for a compromise direction.

More Details

To learn more about antenna installation and incorporating off-air signals into your installation, I highly recommend two sources.

1. The Training Dept's *Broadband RF System Design and Installation* DVD training course. What can say...it is fantastic. www.trainingdept.com/html/videos.html
2. Ken Nist's *fantastic* web site: http://www.hdtvprimer.com/

Ken has TONS of no-BS info on specific antennas, understanding how antennas work, as well as info on HDTV/ATSC in general. Ken definitely knows his "butt from deep center field"!

NEXT MONTH

Next month I want to return to the iPod as test signal generator. I received a lot of good ideas and questions on the use of various types of files for output, cables, etc. So I'm going to put some files on the web site you can use, test some cables, and show how to make a modulator attachment.

Catch you next month….Grayson