



Application Note

AN-11a

Nov. 2011

rev. Oct. 2014

Digital TV DX Record for Colorado

Jim Andrews, KH6HTV

www.kh6htv.com

Note: The original AN-11 was written in 2011 and the cable TV modulation method of 64-QAM was used. Since then, the author has discovered the European Digital Video Broadcast - Terrestrial, DVB-T, modulation scheme. It has been found to be far superior for over-the-air transmissions than CATV 64-QAM, particularly in terms of receiver sensitivity and tolerance of multi-path. The reader of this app. note is also encouraged to read about DVB-T in application note, AN-17. The DX reported here was repeated in 2014 using DVB-T with much simpler Yaggi antennas. See AN-20.

A new Colorado record for long distance transmission of amateur Digital Television (DTV) was set on November 21, 2011. The distance was 75 miles from Cheyenne, Wyoming to Boulder, Colorado. A live, high-definition, (1080i, 16:9) DTV picture was transmitted on 70 cm by Jim Andrews, KH6HTV from a ridge line on I-25 just south of Cheyenne to Bill McCaa, K0RZ, on Davidson Mesa, south-east of Boulder. NTSC, analog, 70cm TV pictures were also successfully transmitted over this same path. There were also three other Boulder hams that participated in the TV dxpedition attempting to receive both the analog and digital TV signals at their home qths. They were Roger Salaman, K0IHx, Don Nelson, N0YE, and Jack Quinn, K0HEH.

Jim was transmitting a 5 Watt DTV signal on channel 58.1 (429 MHz) with a KH6HTV-VIDEO, model 70-8, analog/digital TV transmitter. The antenna was a vertically polarized, KLM, 6 element yaggi with 11 dBi gain at 10 ft elevation. The modulation used was QAM-64, which is the same modulation used on the USA cable TV (CATV) systems. QAM-64 can be received directly on home analog/digital TV receivers without requiring any converter box. Tests were also run using conventional NTSC (480i, 4:3), VUSB-TV. For VUSB-TV, the model 70-8 output power was 25 Watts PEP on channel 57 (421.25 MHz). For details on the TV transmitter see www.kh6htv.com

The secret to the success of this 75 mile DTV DX contact was Bill's really big antenna. Bill used an array of eight, 22 element yaggis with a 0.3dB noise figure pre-amp mounted at the antenna. The antenna gain was 27 dBi. To emulate a more conventional ham TV station, Bill also used a KLM, 6 element yaggi (11 dBi gain) with a

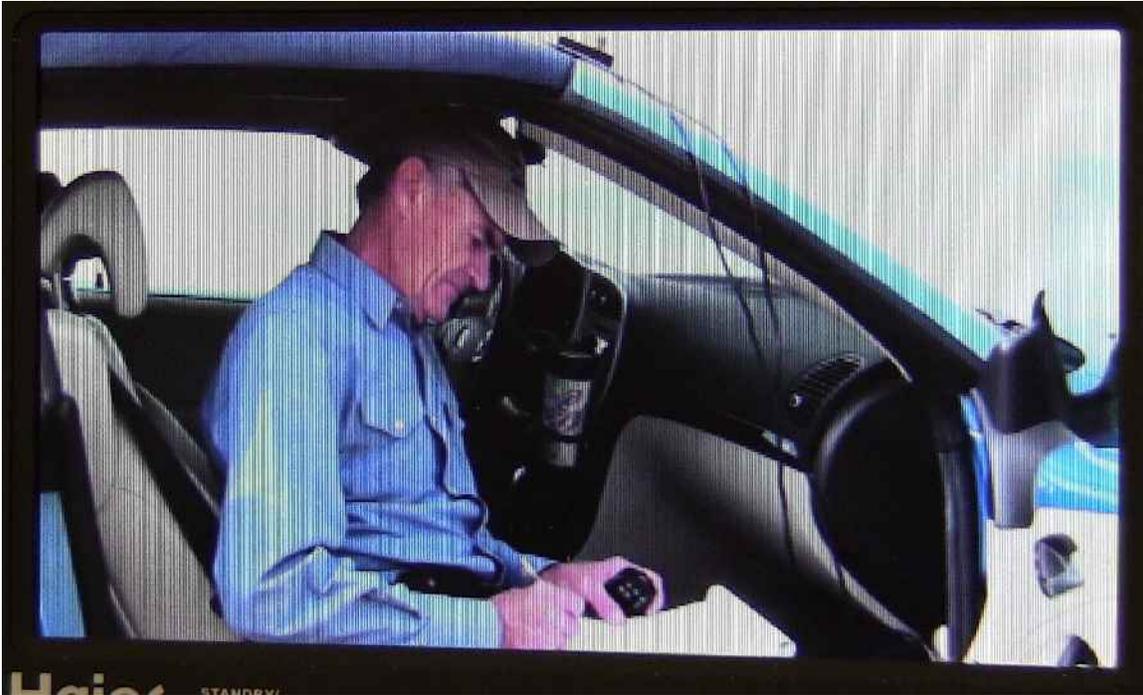
0.5dB NF preamp. The DTV receiver was a conventional Insignia 22" LCD-TV. A precision step attenuator was used in front of the 0.5dB NF preamp/TV receiver to determine the received signal margin above QAM-64 digital threshold (-85dBm).

The 75 mile path from Cheyenne to Boulder was a perfect line of sight rf path with no intermediate obstructions. KH6HTV's transmit location was at 41° 2' 53" N x 104° 53' 26" W at an elevation of 6,265'. K0RZ's receive location was at his qth at 39° 59' 0" N x 105° 10' 6" W at an elevation of 5,620'. The low point on the rf path was at the Cache la Poudre river at an elevation of 4,900'. K0RZ had a lot of prior experience using this particular path for successful 10 GHz SSB contests.

For the Cheyenne to Boulder DTV test, Bill needed to use his big antenna array to receive the 5 Watt DTV signal. The receive margin was 7 dB. No DTV signal was received on the 6 element yaggi. For the 25 Watt analog TV signal, Bill reported a P2 picture on the 6 element yaggi and a P5 picture with the big antenna. Roger, K0IHX, was using an 11 element, 14 dBi, M Squared yaggi antenna, at 27' and no preamp. He was unable to receive the DTV signal, but he reported receiving a P3 picture on the analog TV signal.

On the way out from Boulder, Jim first stopped at two other good sites that Bill had previously used for 10 GHz contests. The first was at the Mead, CO AT&T cell site on I-25, which was a distance of 22 miles from Boulder. All participants were able to receive the analog TV transmission. Bill and Roger reported P5 pictures. Jack, reported P1. When the analog TV transmitter was switched over to Ch. 60 (439.25MHz) it was also able to bring up the BCARES, Boulder TV repeater, W0BCR. The signal strength was at a P5 level, but there was severe ghosting due to multi-path reflections from the Flatiron mountains immediately behind the repeater. For the channel 58.1 DTV transmission, both Roger and Bill received perfect digital, hi-def. pictures. For Bill the receive margin was 13 dB with the 6 element yaggi and 32 dB with the big antenna array.

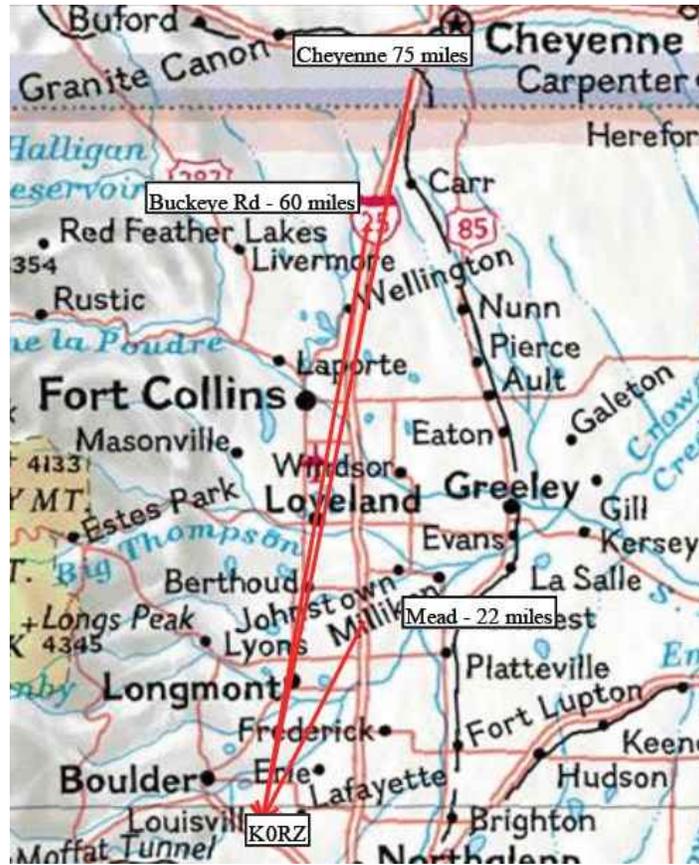
The second, intermediate site was at the Buckeye road exit on I-25 near the Wyoming border. The distance from Buckeye to Boulder was 60 miles. From this location, we were unable to key up the W0BCR TV repeater. For the analog TV transmission, Roger reported a P3/P4 picture. Bill reported a P3 picture with the 6 element yaggi and a P5 picture with the big antenna array. For the digital TV transmission, Roger was unable to receive a picture. Bill reported no picture with the 6 element yaggi but a P5 digital picture on the big antenna array with an 18 dB margin.



High Definition, 1080i, QAM-64, Digital TV transmission from Jim, KH6HTV as received by Roger, K0IHX (photo courtesy of K0IHX)



Bill, K0RZ's 70 cm phased array of eight, 22 element yaggi antennas. Gain = 27 dBi (photo courtesy of K0RZ)



Map showing the RF paths for the 70cm Digital TV DXpedition KH6HTV to K0RZ