Boulder Amateur Television Club

TV Repeater's REPEATER

August, 2022
2ed edition, issue #108

BATVC web site: www.kh6htv.com

ATN web site: www.atn-tv.com

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What Are the Differences in Receiver Sensitivity for 2, 4 & 6 MHz Band-Width DVB-T Signals ?

Jim Andrews, KH6HTV

Recently, in this newsletter there has been discussions on the pros and cons of narrow vs. wide band-widths for DVB-T. It is obvious that we can get high-definition, 1080P resolution, high quality video and CD quality audio with 6 MHz band-width. DVB-T was originally designed to do just that for commercial broadcast TV with either 6, 7 or 8 MHz band-widths. But how well does it work for lower band-widths, such as 4 MHz as used by the ATV hams in St. Louis or 2 MHz as used in southern California and Dayton, Ohio ? So, I decided to run an experiment to measure receiver sensitivity for 2, 4 and 6 MHz band-widths.

My experiment looked at many different settings. I used all three possible modulations of QPSK, 16QAM and 64QAM. I used two different digital encoding FEC settings for what I called "*normal*" and "*aggressive*". "*Normal*" used 8K FFT, 5/6 code rate and 1/16 guard interval. "*Aggressive*" used 8K FFT, 1/2 code rate and 1/4 guard interval. I also tested with and with-out a low noise pre-amplifier in front of the DVB-T receiver.

Test Set-Up: I used a Hi-Des model HV-320E modulator as my DVB-T signal source. I programmed the various operating parameters in it using a Windows 10 PC running the program AV-Sender. The DVB-T receiver used was a Hi-Des model HV-110. It's HDMI output was displayed on an 11", 1080P flat screen monitor. I used a DVD player playing a pre-recorded video to provide a 1080P, HDMI source of "live", full motion

video and audio for the modulator. I measured the rf power out of the modulator using an HP 432A rf power meter with an HP 478A thermistor rf power sensor head. I controlled the rf signal level into the receiver using fixed 20dB and 30dB SMA attenuators plus a Midwest Microwave rotary step attenuator. (0 - 69dB in 1dB & 10dB steps). The low noise pre-amplifier used was a KH6HTV Video model 70-LNA with 21dB gain and 0.7dB noise figure.

Different video data bit rates were required for each and every combination of band-width, modulation and encoding. AV-Sender calculates for each setting, the max. theoretical limit. Hi-Des recommends the data rate not be set any higher than 80% of the max. limit. This is to allow for data overhead and the audio encoding data stream. For lower band-widths and more aggressive encoding, I found it necessary to use an even lower percentage than 80%. The following table lists the data rates I used for the experiment.

Bit Rate Setting Table:

Band-Width	Modulation	Normal/ Aggressive	Max. Mod. Data Rate (Mbps)	scale factor %	Max. Bit Rate (Mbps)
6 MHz	64QAM	Normal	21.96	80%	17
	64QAM	Aggressive	11.2	80%	9
	16QAM	Normal	15.83	80%	12.7
	16QAM	Aggressive	7.46	80%	5.9
	QPSK	Normal	7.16	80%	5.7
	QPSK	Aggressive	3.65	75%	2.7
4 MHz	64QAM	Normal	14.32	80%	11.5
	64QAM	Aggressive	7.46	80%	6.0
	16QAM	Normal	9.76	80%	7.8
	16QAM	Aggressive	4.98	80%	4.0
	QPSK	Normal	4.88	80%	3.9
	QPSK	Aggressive	2.49	70%	1.7
2 MHz	64QAM	Normal	7.32	80%	5.8
	64QAM	Aggressive	3.73	70%	2.6
	16QAM	Normal	4.88	80%	3.9
	16QAM	Aggressive	2.49	72%	1.8
	QPSK	Normal	2.44	70%	1.5
	QPSK	Aggressive*	1.95	66%	1.3

* Note: for 2 MHz BW, QPSK aggressive settings were 2/3 Code & 1/16 Guard. 1/2 code and 1/4 guard did not work.

Media Configuration Settings: H.264 Video Encoding, 60 GOP length, Frame Rate 30 fps, ---- MPEG2 Audio Encoding at 96kbps

Video Resolution: I used 1920 x 1080 for both 6 MHz and 4 MHz band-widths successfully. I tried 1080 on 2 MHz but detected some artifacts in the transmitted video, so I used 1280 x 720 for 64QAM and 16QAM. For 2 MHz BW and QPSK, I found I needed to lower the resolution down to 640 x 480.

Receiver Measurements: For each test, the step attenuator was adjusted to determine the digital threshold. This is defined as the weakest signal for which a perfect, P5 picture and Q5 audio is obtained. Dropping another 1dB caused either total lockout or at least picture breakup with freeze frames. The on screen display (OSD) feature of the HV-110 receiver was used to measure the signal to noise ratio. The following table summarizes the results.

Comparison of Digital Thresholds with & with out low noise, pre-amp:

Band-Width	Modulation	Normal/ Aggressive	HV-110	70-LNA HV-110	Improvement with pre-amp	S/N max / min
6 MHz	64QAM	Normal	-81dBm	-84dBm	3dB	32/22dB
	64QAM	Aggressive	-87dBm	-90dBm	3dB	32/15dB
	16QAM	Normal	-86dBm	-91dBm	5dB	26/15dB
	16QAM	Aggressive	-90dBm	-96dBm	6dB	26/10dB
	QPSK	Normal	-94dBm	-98dBm	4dB	23/8dB
	QPSK	Aggressive	-97dBm	-103dBm	6dB	23/5dB
4 MHz	64QAM	Normal	-83dBm	-86dBm	3dB	32/22dB
	64QAM	Aggressive	-88dBm	-91dBm	3dB	32/15dB
	16QAM	Normal	-88dBm	-91dBm	3dB	26/15dB
	16QAM	Aggressive	-91dBm	-94dBm	3dB	26/12dB
	QPSK	Normal	-96dBm	-97dBm	1dB	23/8dB
	QPSK	Aggressive	-98dBm	-99dBm	1dB	23/5dB
2 MHz	64QAM	Normal	-86dBm	-89dBm	3dB	32/22dB
	64QAM	Aggressive	-92dBm	-95dBm	3dB	32/15dB
	16QAM	Normal	-92dBm	-94dBm	2dB	26/15dB
	16QAM	Aggressive	-95dBm	-97dBm	2dB	26/12dB
	QPSK	Normal	-99dBm	-100dBm	1dB	23/8dB
	QPSK	Aggressive*	-101dBm	-101dBm	0dB	23/6dB

S/N: For QPSK, the max. possible s/n is 23dB. For 16QAM, it is 26dB. For 64QAM, it is 32dB. The lowest possible s/n at digital threshold depends upon the modulation and

the aggressiveness of the FEC. For QPSK it was 8 and 5dB. For 16QAM, it was 15 and 12dB. For 64QAM, it was 22 and 15dB.

6 MHz BW Summary: For normal FEC encoding, the sensitivity measured was -94dB (QPSK), -86dBm (16QAM) and -81dBm (64QAM). Lowering the data rate and using very aggressive Forward Error Correction (FEC) of 1/2 was seen to buy several dB improvement. Also using a low noise pre-amp was seen to add 3 to 6dB improvement.

4 MHz BW Summary: I found it possible to use 1080P for all settings on 4 MHz band-width. For normal FEC encoding, the sensitivity measured was -96dB (QPSK), -88dBm (16QAM) and -83dBm (64QAM). In other words, going from 6 to 4 MHz brought a 2dB improvement in sensitivity. Lowering the data rate and using very aggressive Forward Error Correction (FEC) of 1/2 was seen to buy several dB improvement. Up to 5dB. Also using a low noise pre-amp was seen to add 3dB improvement for QAM. For QPSK it was only 1dB.

2 MHz BW Summary: As mentioned previously one needs to lower the video resolution for 2 MHz BW. 720P works well for QAM. QPSK requires even lower 480. For normal FEC encoding, the sensitivity measured was -99dB (QPSK), -92dBm (16QAM) and -86dBm (64QAM). Lowering the data rate and using very aggressive Forward Error Correction (FEC) of 1/2 was seen to buy at most 3dB improvement with 64QAM and none with QPSK. Also using a low noise pre-amp was seen to add 3dB improvement for 64QAM. 2dB for 16QAM. It had no effect for QPSK.

73 de Jim, KH6HTV, Boulder, Colorado

AB0MY Finds a New HDMI Quad Processor / Switch

Bill, AB0MY, on a recent Boulder ATV net demoed and told the gang about a new slick HDMI Quad Processor which he had just found and purchased. It is made by the Chinese company, AV Access. It is the model 4KMV41. It is sold by Amazon Prime for $180. Bill says the key thing that lead him to buy it was it's capability to be controlled via RS-232. A key element in our W0BTV-ATV repeater was an HDMI quad switch with RS-232 control made by OREI. However, OREI has since discontinued building it. Thus Bill's find is quite important for other ATV groups thinking about building their own DATV repeater.

The new box has 4 HDMI inputs and 1 output. It is capable of handling up to 4K@30Hz signals. The above photo shows the various viewing modes possible with it. AV Access also claims that it has "seamless switching". In Bill's experience, switching from

various sources does seem to be seamless with no HDMI drop-outs. Bill has not yet gotten around to trying out the RS-232 capabilities.

For details on how we used an RS-232 controlled HDMI quad switch in W0BTV, go to https://kh6htv.com/application-notes/ and down-load application note, AN-53b. "W0BTV Boulder, Colorado Digital ATV Repeater Technical Details". see pages 1-4.

New OHIO Weekly ATV Net

The two major ATV groups in Ohio are merging their weekly ATV net. They are the DARA, Dayton and ATCO, Columbus groups. They will now be meeting jointly on Wednesday evenings at 8pm. You can participate with either ATV video, FM voice, or Zoom internet. For details on how to participate, contact either Dave, AH2AR, for DARA or Art, WA8RMC, for ATCO. To find out more about ATCO, check out their web site at: https://www.atco.tv/ For DARA, go to: http://www.w8bi.org/

ATN BBQ: The southern California, Nevada and Arizona chapters of ATN are holding a joint social get together and BBQ pot-luck picnic. It will be on Saturday, August 13th. For details see the attached flier in the Ham Ads section.

Arizona ATN Mesh Networking Workshops

The Arizona chapter of ATN are holding monthly workshops on Mesh Networking. They are held monthly on Saturday afternoons at Rod, WB0KMO's QTH in Mesa, AZ. The first one was held on Aug. 6th.

Rod, in his announcement flier writes ----- This is an excellent opportunity to get hands-on knowledge and experience with mesh networking. This is an excellent opportunity to get hands-on knowledge and experience with mesh networking. These monthly sessions are for mesh networking beginners and experienced users who want to learn new things, improve mesh operations and help us grow. Everyone meets new hams, has fun and learns something new. We discuss ATV, DMR and other ham topics, as well. Show and tell us about what you're passionate about in ham radio. You may find that many of us are interested in that too.

Today (Aug. 6th), among other things, we want to learn how to set up cameras on the Mesh. Several models will be available to play with. Bring your camera to add to the fun. Bring ham equipment to get help with or to sell. I have lots of test equipment on hand to use. Buy something here and get it configured for you so you can immediately be on the air. See what we already have on our Mesh Network and how to access many services

that are available. See what the Arizona Mesh Organization is all about and how you can be part of it. For more information, contact Rod at: wb9kmo@gmail.com

Spot Light on ATVers

We would like to highlight here in our ATV newsletter, some of the "Movers & Shakers" in our ATV community. One of them is

Rod Fritz, WB9KMO

Rod has a long history of involvement with ATV. Rod has given talks introducing ATV to various ham clubs. This has included organizing special sessions on ATV for recent QSO Today Virtual Ham Expos.

Rod grew up in Waupun, Wisconsin. He's the father of three fine young adults, not hams yet, who live in California. In 1971, he became a Radio Amateur (now Extra Class) while attending Electrical Engineering at University of Wisconsin - Madison where he was a DJ and Chief Engineer at WSRM radio. He maintained computer mainframes in Madison for Burroughs Corporation and passed up a broadcasting career at WMTV in Madison to move to Santa Barbara to prototype mini-computers and write technical manuals. In the 1980s, he was a pioneer PC and network dealer in California. Switching from hardware to software in the 1990s, he became a database administrator and computer systems analyst for the County of Santa Barbara. He retired after 22 years in 2014 and now lives happily in Mesa AZ.

Rod was always attracted to specialized communication modes and has worked virtually all of them. He focuses on amateur television, maintains Amateur Television Network (ATN) repeaters in Santa Barbara, CA, and Mesa, AZ, and enjoys mesh networking, especially Mesh Video. He links ATV repeaters together with microwaves and over the Internet, enjoying the challenges and rewards. The technical learning opportunities drive him but Rod mostly values the friends he meets along the way.

Rod is currently the Vice President of Amateur Television Network - Arizona (ATN-AZ) and the ATN-CA trustee of the Santa Barbara ATV Repeater. You can watch their ATV Nets on YouTube.com/AmateurTelevisionNetwork Sunday, Tuesday and Wednesday evenings between 7 and 9 PM Arizona Time.

ATV News from San Diego

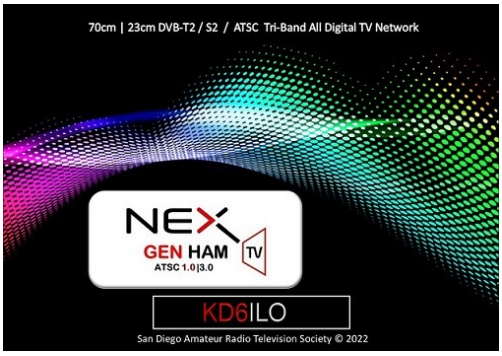
We are in the test phase of our new UAV video platform as demonstrated near our TV studio parking lot in Carlsbad [Thomas, myself, Jane and Randy, UAV FAA Part 107 Pilots] for our group. Test conducted on Aug 2nd 2022. Thanks to our ongoing support funding, this will also support our EMCOMM SAR support for our first responders in San Diego County, to include the Coastal Watch Group.

73 de Mario, KD6ILO

The San Diego Digital Amateur Radio Television Society (SDATV) has ATV repeaters. They also now operate FCC licensed Low Power TV stations (LPTV) in Ramona, CA and Oceanside, CA. Both stations are running the new USA digital broadcast standard, ATSC 3.0 To find out more about LPTV, check out the FCC web site:
https://www.fcc.gov/consumers/guides/low-power-television-lptv-service

Ramona Remote Control Room

Oceanside Studio Control Room



SDATV Oceanside Studio production of "Old Timer's Net"

W0BTV Details:

Inputs: 439.25 MHz, analog NTSC, VUSB-TV; 441MHz/6MHz BW, DVB-T & 1243 MHz/6MHz BW, DVB-T
Outputs: Channel 57 --- 423 MHz/6MHz BW, DVB-T, or optional 421.25 MHz, analog VUSB-TV. Also, secondary transmitter, FM-TV output on 5.905 GHz (24/7).
Operational details in AN-51a Technical details in AN-53a. Available at: ***https://kh6htv.com/application-notes/***

W0BTV ATV Net:

We hold a social ATV net on Thursday afternoon at 3 pm local Mountain time (22:00 UTC). The net typically runs for 1 to 1 1/2 hours. A DVD ham travelogue is usually played for about one hour before and 1/2 hour after the formal net. ATV nets are streamed live using the British Amateur TV Club's server, via: *https://batc.org.uk/live/kh6htvtvr* or *n0ye or ab0my*. We use the Boulder ARES (BCARES) 2 meter FM voice repeater for intercom. 146.760 MHz (-600 kHz, 100 Hz PL tone required to access).

Newsletter Details:

This is a free newsletter distributed electronically via e-mail to ATV hams. The distribution list has now grown to about 500. News and articles from other ATV groups are welcomed. Permission is granted to re-distribute it and also to re-print articles, as long as you acknowledge the source. All past issues are archived at: https://kh6htv.com/newsletter/

ATV HAM ADS

Free advertising space is offered here to ATV hams, ham clubs or ARES groups. List here amateur radio & TV gear For Sale - or - Want to Buy.

ATN

The Amateur Television Network

ATN TRI CHAPTER SUMMER BBQ ANNOUNCEMENT

Arizona, California & Nevada

Our summer ATN family BBQ social and equipment tuneup clinic will be Saturday August 13 at the QTH of Tom and Chris Board's QTH in Rancho Cucamunga, CA. Doors open at 11 AM and BBQ lunch starts at noon. The tuneup clinic will be availible after lunch. As we have done in the past, ATN will provide the meat and guests are asked to bring a side dish to share. Members may bring family members or a guest. Tom will also have a swap table for those wanting to sell unused ATV gear.

Please RSVP Tom at taboard17@gmail.com or 909-472-1410 and advise how many in your party, side dish you would like to bring. If you are planning to bring equipment to test, please advise Tom. Address for Tom and Chris's QTH is 8236 Matterhorn Court, Rancho Cucamunga, CA 909-472-1410. 146.43 MHz simplex will be monitored as well as our ATN voice repeater linked system.

We look forward to seeing you soon, Tom & Chris.