



## Application Note AN-9 October, 2011

# Add Television To Your ARES Tool Kit

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This is a TV success story for a local ARES group. The Boulder County Colorado ARES group (District 11), BCARES, has experienced a lot of success working with our county's emergency services organizations, in particular, fire and law enforcement. BCARES's tool kit includes all of the ordinary ham services, including HF/VHF/UHF voice communications, repeaters and various digital modes on HF plus packet on VHF/UHF with back-bone linked digipeaters.

***What Boulder County Public Safety lacked most and BCARES had to offer was --- TELEVISION.*** Ham television is the one BCARES capability that really excites our served public safety agencies. BCARES started offering TV services about 20 years ago, when I was the chairman of BCARES. We added TV at the encouragement of Cpt. Bill McCaa, K0RZ, of the Boulder County Sheriff's Office. Bill was in charge of all of the Sheriff's communications and computer operations and the county regional 911 center. Over the past few years BCARES has received many more requests for assistance using TV than for all other communication modes.

TV offers "Public Safety" information in ways never imagined by us or our served agencies. Television has come to be appreciated by our served public safety agencies because it provides what they refer to as "situational awareness". It helps remove the need for many voice communication exchanges for information that is already contained in the video imagery. Television allows the incident commander at the Incident Command Post (ICP) to actually see what is happening at the scene(s) of the incident, be it a fire, flood, hazmat, riot, or SWAT

operation. With this information, the incident commander is better able to make appropriate command decisions. Via our 2 meter, TV net controller, the Incident Commander is able to request BCARES cameras provide him with specific images and information. BCARES is able to routinely provide television and all of its other communication services in a completely infrastructure free manner.

Many times every year, BCARES is asked by our local law enforcement and fire departments to provide TV coverage of both real emergencies and also multi-agency training exercises. These have included situations such as large, multi-agency forest fires, flash floods, hazardous materials incidents, civil disturbances, large political demonstrations and protests, Halloween on the Pearl St. mall, University of Colorado football games and SWAT operations. Boulder County ranks as the leading flash flood threat zone in the state of Colorado and BCARES is specifically written into County emergency planning.



Fig. 1 BCARES live video feed from mountain top to 911-EOC of slurry bomber fighting the Four Mile Canyon forest fire in Boulder County.

BCARES' most shining moment occurred in Sept. 2010 when the worst forest fire in Colorado history broke out in Boulder County. The Four Mile Canyon fire burned over 6,400 acres of forest and destroyed 166 homes. BCARES assisted firefighters providing live TV coverage from mountain tops back to the 911 center for a week. At the end BCARES was credited with saving several homes. More details are found in a paper published in the May, 2011 issue of QST [1]

BCARES was organized and incorporated by Boulder County and the local ham clubs, in 1977 after the disastrous Big Thompson Canyon flash flood which claimed 144 lives. The official office of BCARES is in the Boulder County Office of Emergency Management (OEM), in the county 911 center. BCARES is recognized by the OEM as being both the ARES and RACES organization for the county. With the recent creation of the adjacent city and county of Broomfield, BCARES also provides its services to Broomfield. BCARES presently has about 80 active members and approximately 30 "reserve" members. Every member is required to be approved by the Boulder Sheriff after a thorough back-ground check. Upon approval, each member is issued a formal Sheriff's department photo identification card. A small sub-set of specially trained, volunteer BCARES members are also on the Sheriff's SWAT team and respond automatically with the team whenever it is paged out for an operation. BCARES is funded by contributions from FEMA, served agencies along with private and corporate donations. The Sheriff allows BCARES to use several of its remote radio sites and microwave links for repeaters. The mobile command post vehicles for the Sheriff as well as Boulder Police and Longmont Police all include a BCARES 2 m radio, along with capability of receiving BCARES TV transmissions. The Sheriff and OEM also provides BCARES with an operating position in the county 911 dispatch center along with a storage room for use as an equipment cache with 24/7 access. Equipment in the cache includes a complete portable HF station with PACTOR III capability, multiple 2 m packet stations, backpack 70 cm TV transmitters and portable 70 cm TV repeater. Equipment caches are also maintained at the University of Colorado police dept. and the Longmont police dept. The only personal equipment requirement for BCARES members is that they own a synthesized, 2 meter, hand-held radio. Naturally,

many members also have much more complete 'to-go' kits and are a resource of a lot more communication equipment.

When most hams think of ham ATV, they immediately assume slow-scan TV. This is not what BCARES does. Our TV is commercial grade, analog NTSC, real-time, live, video with full color and sound transmissions. On the 70 cm ham band, we run full 6 MHz bandwidth, vestigial upper side-band (VUSB) TV transmissions. We use the same frequencies as used by cable TV. This allows our TV signals to be received directly on unmodified, cable-ready, TV receivers. For example, cable channel 57 = 421.25 MHz, channel 58 = 427.25 MHz, etc. We also use the ham 23 cm and 13 cm bands. On those bands, we use FM-TV.

A few Boulder County hams actually have their own home ham TV stations. With the exception of a Monday night TV net, there is little routine ham TV activity in the county. However, when we have a BCARES operation going, there may be as many as four or five TV channels light up and become active simultaneously on the 70 cm and 23 cm ham bands. Out of the 80+ BCARES members, about one half are TV trained and capable of operating our TV equipment.

When using TV for ARES operations, the same FCC rules and guidelines apply as for voice and data transmissions. Use common sense and decency along with the FCC rules to determine what are appropriate pictures to transmit. BCARES has turned down some requests for TV, typically for foot and bicycle races, when we determined they were for commercial, rather than bonafide public safety purposes. As with any other ham transmissions, TV must also be identified at least every 10 minutes. We do this visually by holding up a small QSL type card in front of the TV camera lens. Because we are also usually transmitting audio along with the video, it is well to also make a voice ID announcement simultaneously. Our TV repeaters do this automatically with Morse code and also color bar, call sign, video ID generators.

BCARES uses commercial, off the shelf, consumer grade, Sony video camcorders. Our latest cameras are high-definition, but we only transmit conventional composite, NTSC, standard definition pictures. Using 1080i, high-definition cameras still results in much better quality images, even when transmitted in analog

480i, standard definition. The Sony camcorders include an infra-red, night vision mode capability which has been found extremely useful for low light operations. Figure 2 shows actual live, night time, images seen by the Fire Chief of a 2002 forest fire on the outskirts of Boulder. They offered extremely revealing, night time, video images to the fire chief of hot smoke clouds from a forest fire which were not at all obvious to the naked human eye. In the bottom image, through a long telephoto lens, the chief was able to follow the progress of his fire crews advancing up the mountainside towards the fire line.



Fig. 2 Night time, BCARES, video images of a forest fire on the mountains adjacent to the city of Boulder

In our 911 center equipment cache, we have several complete, portable TV transmitters packaged in backpacks. They are complete ready to go kits with Sony HD-TV camera, tripod, transmitter, antenna and battery. A Diamond SRH-999, flexible, 70 cm antenna is mounted high on the camera tripod, see Fig. 3, with a coax feed from the transmitter in the backpack. We have found this arrangement dramatically improved the radiation gain over a

rubber duck antenna stuffed into the backpack next to a human body. In the video backpacks, we use a 12 V, 7 Amp-hr battery which is sufficient to allow continuous, key-down, TV transmission for more than 3 hours.



Fig. 3 The Sony hi-def. camcorder and 70 cm, whip antenna, both mounted on a tripod.

Our 70 cm, backpack, TV transmitters are typically 1 to 3 watt output power and include a Spectrum International, interdigital, 6 MHz, VUSB channel filter. Our 20 year old, 1 watt TV transmitters were formerly crystal controlled units from P.C. Electronics. They have now been phased out and were replaced with new, synthesized, 3 watt transmitters from VideoLynx. The VideoLynx VM-70X, synthesized, AM-TV, transmitters, designed by Ravi Goonasekeram, KA3NNJ, produce high quality NTSC video and audio and are very small modules. The spectrum of these AM-TV transmitters is however extremely broad and far in excess of the FCC 6 MHz channel specs. To be able to operate more than one transmitter simultaneously in the 70 cm band, we have to filter their outputs with VUSB channel filters. The VideoLynx transmitters run extremely hot and require heat sinking. We used the interdigital filter as the heat sink. One problem with the Video Lynx was that two of it's four synthesized channels (426 & 434) were incompatible with our local TV band plan using exclusively standard CATV channels. Our BCARES chairman contacted Ravi and was able to convince him to supply us with special, customized units operating on all four standard CATV channels, 57-60





Fig. 4 KH6HTV, 10 Watt, 70 cm, synthesized, NTSC, analog, VUSB-TV transmitter

In 2010, BCARES started upgrading some of their transmitters with the new KH6HTV, 10 watt, 70 cm, VUSB-TV transmitter [2, 3] for mobile operations, Fig. 4. It is fully synthesized to cover all of the cable channels in the 70cm band and produces a 6 MHz wide VUSB spectrum that does not need an external channel filter. For mobile operations, we use a magnetic mount, 70 cm, gain antenna. For extreme situations, we also will deploy large, high gain, yaggi antennas on tripod mounts, or tall portable towers.

For reception of BCARES TV at the incident command post, BCARES has built a couple of portable, quad TV receiver boxes, see Figs. 5 & 6. These are capable of receiving up to four different TV signals simultaneously. This receiver includes four, high quality, CATV head-end demodulators which are tuned to channels 57, 58, 59 & 60. A low noise figure preamp is used, followed by a 4 way CATV splitter for the CATV receivers. Receivers are also included to receive FM-TV on either the 23 cm or 13 cm bands. Provisions are also included to have hard-wired video feeds into the receiver box. Up to four desired incoming video feeds are selected as inputs to a video quad processor. The output from the quad processor is a single NTSC baseband video signal with the four video feeds presented in each of the four quadrants. This is then displayed on a large, flat screen video monitor. When desired, a single video feed can be displayed on the video monitor. The quad processor video is recorded on a VCR. Video distribution amplifiers (VDAs) are used to provide multiple outputs. A channel 3 video modulator RF output is also provided to send the

received video to other remotely located TV receivers for viewing by other police and fire personnel. Also included in the quad receiver box is a 2 m, FM voice radio which is used to communicate with the BCARES TV camera crews. A single tri-band (2 m, 70 cm & 23 cm) antenna is used with this receiver. We use either a Diamond model NR-2000 mobile antenna or an X-6000 base station antenna. The antenna signal is split in the receiver using a Diamond model MX-3000N triplexer. We are able to transmit on this common antenna, a 2 meter signal without interfering with either the 70 cm or 23 cm TV reception

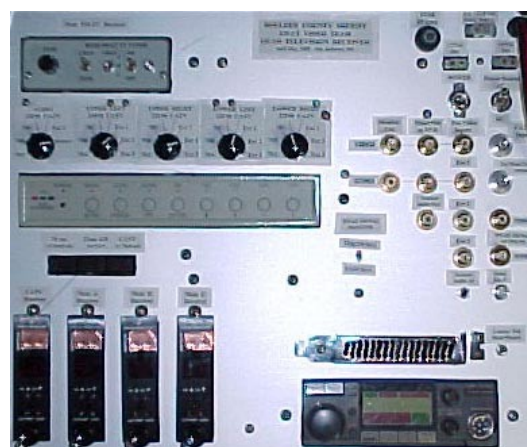


Fig. 5 Portable Quad TV Receiver for the Incident Command Post



Fig. 6 BCARES TV Video Net Control in the CU Police Chief's command post at a University of Colorado football game. Dave, KI0HG and Mark, KB0LRS are using a quad tv receiver box.

BCARES also has a permanent 23 cm / 70 cm TV repeater located in Chautauqua Park, 600 feet above the city of Boulder. It provides good coverage over the flat plains of the eastern half of our county (elevation 1 mile high). For operations in the mountainous western half of our county, with mountains up to 14,000 ft high, we deploy a portable 70 cm TV repeater. Both repeaters use 10 watt transmitters with effective ERPs of 100 watts. The output of both repeaters is on channel 57, 421.25 MHz. The repeaters operate under the BCARES club call sign of W0BCR. Also, sometimes we will relay the ICP quad video receiver picture to the OEM or

police station over a microwave point-to-point link, using a 23 cm, FM-TV transmitter and high gain loop yaggi antenna.

Television has proved to be very useful to the Boulder County public safety agencies and as a result has gotten a lot more hams active in public service. There is nothing worse than having a group of dedicated ham ARES volunteers that never get called upon to serve. After awhile they lose interest. Then, when they are really needed, they are not there or maybe worse, they are untrained. With TV, that has happened far less to BCARES. We get called upon a lot. We recommend that other ARES groups consider adding TV to their "Tool Kits".

#### REFERENCES & NOTES:

- [1] Jim Andrews, KH6HTV "Boulder Hams Fight Forest Fires With Video", QST, May, 2011, pp. 76-77
- [2] Jim Andrews, KH6HTV, "Home-Brew TV Transmitter Production Line", BARC's BARK, Nov. 2010, pp. 3-4
- [3] The KH6HTV, 10W, VUSB-TV transmitter, Fig. 4, is the KH6HTV-VIDEO model 70-1. It is now a discontinued model due to the obsolescence and unavailability of a critical component.
- [4] A paper similar to this was submitted to ARRL - QST magazine in Nov. 2009. It was rejected by QST in Feb, 2010. An updated and slightly revised version was printed in BARC's BARK, Dec. 2010, pp. 3-6. This paper is another, updated, revised version. (10/11).
- [5] Permission is granted to reprint this article as long as the source and author is acknowledged