Date:	2-Mar-00, General CARES Meeting
Session:	Emergency Communications with the Red Cross
Speaker:	Scott Hensley KB6UOO, David Barr, Red Cross, Santa Clara Valley
Summary:	Orientation of comms procedures between shelters and the Red Cross

1. General

Amateur TV (ATV) is one of many visual modes we can use
Two types of ATV:
Fast Scan TV (FSTV)
Slow Scan TV (SSTV)

- ATV is a wide-band mode that uses standard broadcast, or NTSC, television scan rates
- Hams can transmit video from a variety of sources
- Any standard TV can view ATV signals
- Any FCC Licensed Technician Class Amateur Radio operator can transmit and receive live action color video and sound to other hams just like commercial broadcast TV with readily available equipment.

Definitions:

- Amateur TV (ATV): A mode of operation that Amateur Radio operators can use to exchange pictures from their stations. The two types of ATV modes are Slow Scan and Fast Scan TV.
- Slow Scan TV (SSTV): A mode of operation in which Amateur Radio operators exchange still pictures from their radio stations.
- Fast Scan TV (FSTV): A mode of operation in which Amateur Radio operators exchange live TV images from their stations. This training focuses on Fast Scan TV and we will refer to it as ATV.

2. Anatomy of an ATV Station

Any FCC Licensed Technician Class Amateur Radio operator can transmit live color video and sound to other hams with our own equipment.

Definitions:

- Video Source: Can be one of many sources including a Camcoder, video camera, VCR machine, or a computer
- Transceiver: Shown above, provides both transmit and receive capabilities. However, separate transmitters and receivers also are available.
- Power Amp: Boosts the power of the transmitted signal.
- TV: This is the monitor for the system
- Power Supply: Provides 12VDC to all system components. Power supply should have the amperage capability to supply 100% of the current for the system components.
- Antenna: High gain antennas improve signal quality over longer distances.

3. Transmitters and Receivers

Transceiver: Shown here, the TC70-20 20 watt Transceiver is capable of sending and receiving snow-free video over 100 miles assuming line of sight between 14 dBd antennas.
Receiver: Shown here, the TVC-4G Downconverters is a receive-only unit.

The equipment shown here is for example only and is available from PC Electronics, one of several ATV equipment suppliers service the Amateur Radio community.

Reference: PC Electronics

4. ATV Band Plan

420 - 450 MHz
420.00-426.00 ATV repeater or simplex with 421.25 MHz video carrier
426.00-432.00 ATV simplex with 427.25 MHz video carrier frequency
438.00-444.00 ATV repeater input with 439.25 MHz video carrier frequency

902 - 928 MHz
909.00-915.00 Amateur TV
921.00-927.00 Amateur TV

1240 - 1300 MHz
1240-1246 Amateur TV #1
1252-1258 Amateur TV #2
1260-1270 Simplex ATV, Experimental, Satellite Uplinks
1276-1282 Amateur TV #3
1288-1294 Simplex ATV, Wide-band Experimental

2300 - 2450 MHz
2390-2396 Fast Scan TV
2418-2430 Fast Scan TV
2438-2450 Wideband FM, FSTV, FM TV

Reference: ARRL Repeater directory, 1996-1997

5. Why the need for RF Power - The impact of Bandwidth on Power

For FM voice, 100% of spectrum power is delivered into a 10 kHz wide signal centered on the carrier. For Video, 90% of spectrum power is delivered into 1 MHz wide signal centered on the carrier.

- The above picture compares the bandwidth of an FM voice channel (for instance, as found in the 2 meter band) with the bandwidth of a video signal.
- Standard broadcast TV channels are 6 MHz wide to accommodate the composite video, 3.58 MHz color, and 4.5 MHz sound subcarriers.
- The lowest frequency Amateur band wide enough to support a TV channel is 70 cm and is the most popular.

6. Why the need for RF Power - What Commercial Stations do

Station	Locn	Chan	ERP(Kw)	HAAT(ft)	Pattern	Service
KRON	SF	4	100	506	Directional	Analog
KGO	SF	7	316	509	Non-directional	Analog
KICU	SJ	36	4070	686	Directional	Analog

Under Construction

Station	Locn	Chan	ERP(Kw)	HAAT(ft)	Pattern	Service
KRON	SF	57	1000	446	Directional	Digital
KGO	SF	24	561	437	Directional	Digital
KICU	SJ	52	1000	668	Directional	Digital

Definitions:
- ERP: Effective Radiated Power, system power output after transmission losses and antenna gain.
- HAAT: Height above average terrain.

- Radiating Pattern: Identifies the station as using either a directional or non-directional antenna. Stations with Directional Antennas have higher ERP because of the ability to focus the transmitted energy.
- Service: Type of commercial service. Most service is still analog based on the NTSC analog signal standard. High Definition TV (HDTV) is a Digital Service and, in most cases, is still under construction.

This chart describes some of the characteristics of three San Francisco Bay Area TV stations. Note the following:

- Actual Transmitted power was not available.
- KRON and KICO both use directional antennas while KGO uses an non-directional or omni-directional antenna

Also, all three stations have construction permits on file with the FCC in preparation for moving to deliver a High Definition TV digital service. All three stations are planning for higher ERP levels for their new stations.

7. Why the need for RF Power - What KGO-TV does

KGO-TV's antenna is located on Sutro Tower in San Francisco. Because of the non-directional radiating pattern of their antenna, about 120 ° of signal are radiated out to sea where the TV market is undoubtedly low.

For KGO's new digital service, they are planning a Directional Antenna that has the following planed radiating pattern:

0°	0.930	90°	0.818	180°	0.127	270°	0.817
10°	0.874	100°	0.832	190°	0.129	280°	0.751
20°	0.749	110°	0.833	200°	0.134	290°	0.646
30°	0.792	120°	0.779	210°	0.296	300°	0.731
40°	0.974	130°	0.675	220°	0.513	310°	0.949
50°	0.950	140°	0.530	230°	0.659	320°	0.972
60°	0.725	150°	0.306	240°	0.768	330°	0.784
70°	0.634	160°	0.133	250°	0.827	340°	0.736
80°	0.740	170°	0.131	260°	0.827	350°	0.862

Note the anticipated drop-off of power in the range of 150 ° to about 220 °

Reference: www.fcc.gov

8. Why the need for RF Power - What KICU-TV does

KICO-TV's antenna is located east of San Jose in the foothills. This antenna is a directional antenna and has a tuned radiating pattern to ensure the bulk of the signal is received by areas in the Bay Area viewing markets. Note the fall-off of the signal east of the antenna (a fairly rugged and unpopulated area).

As listed on the FCC's website for commercial TV stations, the following is the published antenna pattern for KICU's existing analog service:

0°	0.680	90°	0.270	180°	0.550	270°	0.570
10°	0.540	100°	0.190	190°	0.470	280°	0.670
20°	0.450	110°	0.250	200°	0.430	290°	0.770
30°	0.370	120°	0.490	210°	0.420	300°	0.850
40°	0.280	130°	0.660	220°	0.430	310°	0.920
50°	0.220	140°	0.760	230°	0.430	320°	0.980

60°	0.180	150°	0.760	240°	0.430	330°	1.000
70°	0.260	160°	0.710	250°	0.440	340°	0.940
80°	0.300	170°	0.640	260°	0.480	350°	0.830

Reference: www.fcc.gov

9. Why the need for RF Power

In short, Directional Antennas have a significant effect on the delivery of a signal. This will be critical for CARES and its own ATV implementation.

Directional Antennas: The RF horizon over flat terrain with an antenna placed on a 50 ft tower is 10 miles. The higher the gain the antenna, the better the distance of the signal. For instance, the following table relates TX (transmit) and RX (receive) antenna gains to distances in miles for 1/10/100 W PEP at 440 MHz.

	TX Antenna			
	0db	**4 dBd**	**9 dBd**	**15.8 dBd**
RX Antenna				
0.0 dBd	0.8/2.5/8	1/3.5/11	2/7/22	5/15/47
4.0 dBd	1/3.5/11	2/6/19	3.5/11/34	7.5/23/75
9.0 dBd	2/7/22	3.5/11/34	6/19/60	13/42/130
15.8 dBd	5/15/47	7.5/23/75	13/42/130	29/91/290

Reference: ARRL Handbook, 2000, page 12.47, Table 12.16

10. Commercial Field TV Deployment

I had a chance to observe a remote transmission by a KICU TV crew covering a local story. Their mobile transmission van was situated in the parking lot with the camera tethered about 100 to 200 ft away at the end of an audio and video cable. The system to make the remote live link happen included:

- 35 Watt transmitter in the van
- 26 dB gain antenna at the van
- 26 db gain antenna situated on top of an Easy Bay hill that KICU used as a commercial video repeater site

Prior to the live feed, the operator in the van raised the antenna (about 25 feet), began transmitting a test pattern, and began steering the antenna to point it at the East Bay Hill commercial repeater site. At the same time, an operator back at the studio was remotely steering the high gain antenna at the repeater site to point at the van.

The ERP of this configuration can be calculated using the following formula:
db = 10log (ERP/Ref_Power).
Assuming the following:

Ref_Power:	35 watts
Antenna Gain:	+52 dB
System Loses:	-20 dB (a guess)
Total Gain:	+32 dB
Calculated ERP:	55.5 Kwatts

11. Ways to View ATV

The 70cm band is also lowest cost and easiest to get on. To see your first picture it may be as easy as turning your cable ready TV from cable channel 57 through 60 and connecting your TV or cable box to a good outside 70cm antenna. Cable channel 57 is 421.25 MHz (not to be confused with over the air channel 57), the most common ATV repeater output, and 60 is 439.25 MHz, the highest frequency used in the band (TV channels are spaced 6 MHz).

A test performed by an ATV Repeater Club in Oregon revealed that that both the transmitting and receiving station must have good antennas with a short run of quality coax to have a quality picture with audio. Test transmissions to local sites with a downconverter and a cable ready television with UHF antenna shows that the downconverter is required for quality signal, but the set without a downconverter does receive adequate signal, but audio and video signals are fair to poor. Testing is still being done to find a quality site for a test repeater.

12. ATV in Cupertino, Phase 1 - Initial Deployment

The first CARES implementation of ATV includes formally establishing an ATV receive capability at Cupertino City Hall. The equipment needed to support this is:

- High gain 440 antenna
- Antenna rotator and controller
- 440 ATV tuner

Additionally, ATV operator field training will be provided to CARES members. For the Mobile ATV station, there is already one CARES member with mobile ATV capabilities. Additional mobile stations may be assembled based on the City's requirements for this service in support of an emergency response.

A typical operational scenario is as follows

- The Mobile ATV station consisting of at least 2 CARES members is dispatched by the
- EOC to an area of interest. Their Tactical Call Sign is ATV-1.
- On arriving at the assignment, the ATV crew raises a high gain antenna, connects the camera to the transmitter, and sends a test signal. The ATV operator uses the CARES TAC-2 frequency to coordinate with the EOC to ensure the antenna is pointed correctly and the best possible signal is received. The EOC Operator also steers the EOC high gain antenna to point at the ATV crew.
- If the quality of the signal is not sufficient, the RF Power Amp will be turned on to boost the transmitted signal.
- CARES will transmit its ATV signal on on 427.25 MHz.

13. ATV in Cupertino, Phase 2 - Mobile Unit enhancement

To extend the reach of the Mobile unit, CARES will implement a Portable ATV unit that allows the Mobile ATV system to operate as a repeater between the Portable unit and the EOC. The equipment needed to support this extension is:

- 900 MHz Transmitter to be mounted with the camera

At the Mobile Unit,

- 900 MHz Receiver
- 900 MHz high gain antenna
- UHF to composite video converter
- Monitor

A typical operational scenario is as follows

- The Mobile ATV station is dispatched by the EOC to an area of interest.

- On arriving at the assignment, the ATV crew raises a high gain antenna and sends a test signal to the EOC. As previously described, both antennas are aligned for the best signal.
- The Portable ATV package is powered up and a test signal is sent from the Portable ATV unit to the Mobile ATV unit. The Mobile ATV operator monitors the Portable ATV signal on the local monitor.
- As required, the Mobile ATV operator patches the Portable ATV signal through the Mobile ATV transmitter to the EOC.
- CARES will transmit on 427.25 MHz from the Mobile ATV unit and in the 900 MHz band from the Portable ATV unit.

End of summary