Amateur Television (ATV)

This presentation is a brief introduction to give insight of ATV, how to get started, and how to get more information on ATV.

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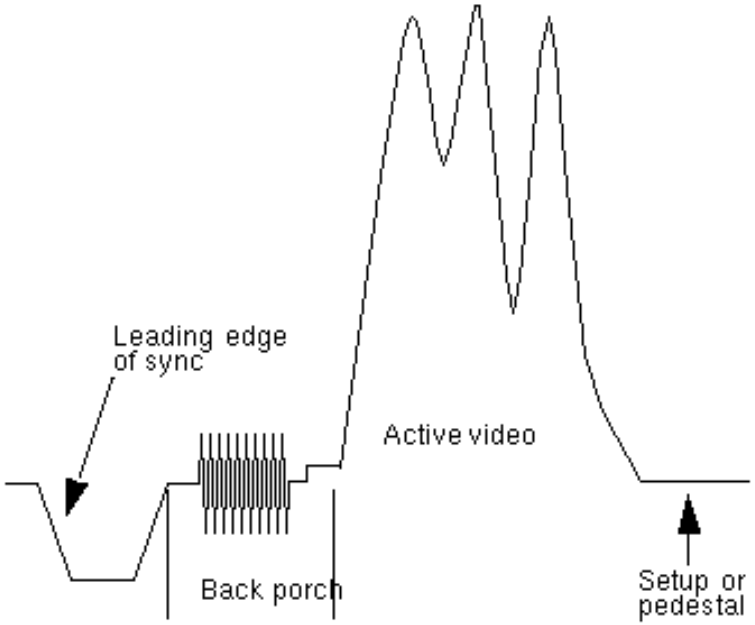
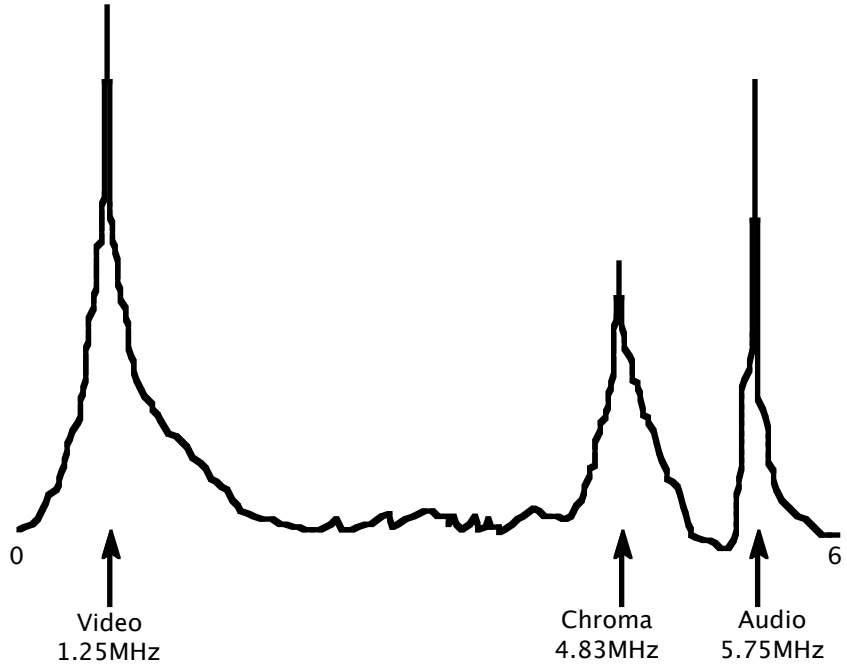
Amateur Television (ATV) Basics

ATV is transmitting television through the air like commercial broadcasters. Presented here is fast scan analog television (NTSC). Slowscan television (SSTV) is another popular form of ATV but does not provide realtime transmissions. Digital TV (ATSC) not commonly used (yet) in amateur radio because there are lots of legacy analog equipment still in use.

Camera (camcorder) provides a 1 volt composite signal to a video transmitter (or modulator), typically with a yellow RCA connector. Transmitter emits a 6MHz AM signal. Video carrier centered at 1.25MHz from beginning of spectrum, audio carrier 5.75MHz from beginning of spectrum. Peak in between is the chroma signal. Shown below is the upper sideband of AM video signal (vestigial sideband, VSB). Amateur TV transmitters from sources such as PC Electronics transmit both upper and lower sidebands (dual sideband, DSB).

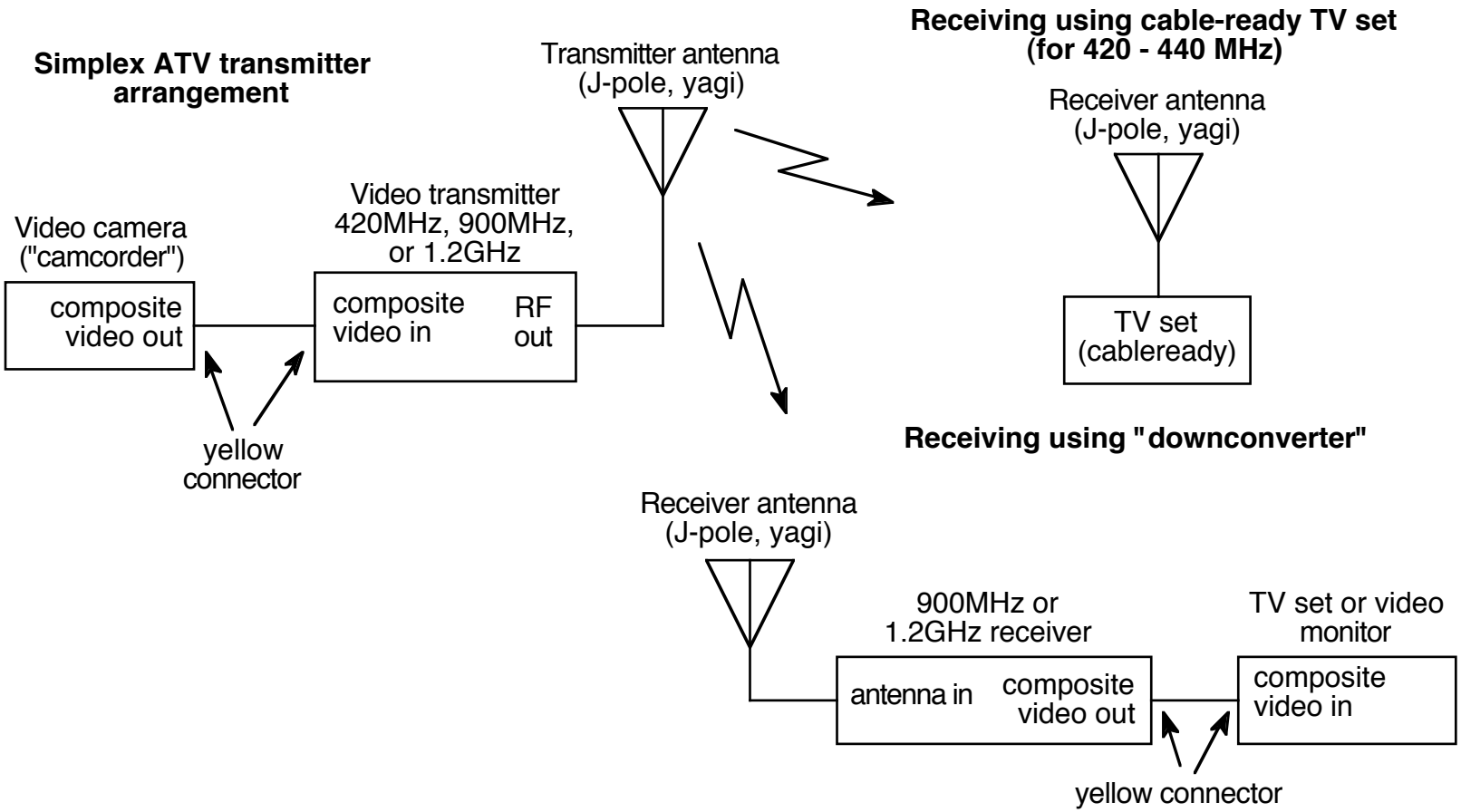


Waveform of a 1 volt composite video signal



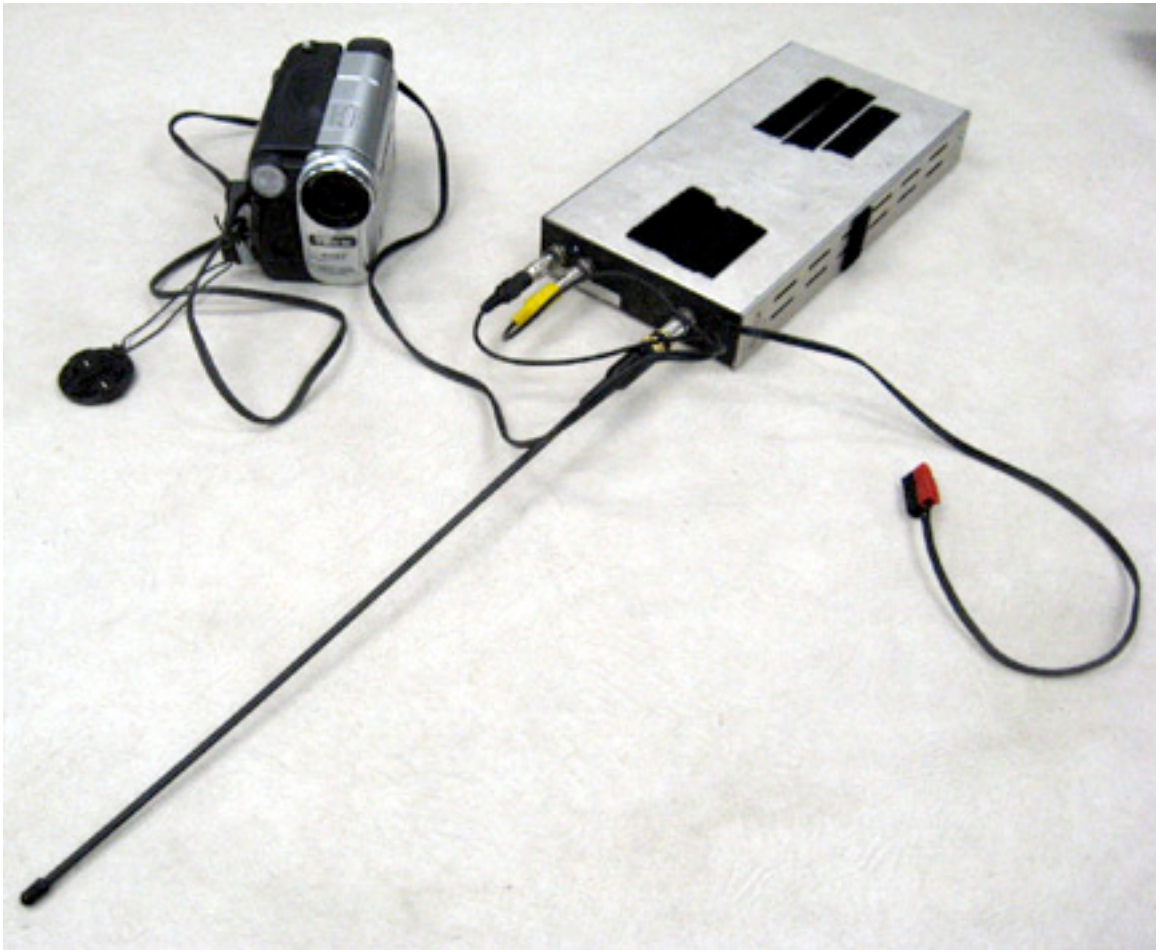
Freq spectrum (vsb) of a video transmission

Simplex ATV



Compare this block diagram to actual simplex ATV transmitter packages shown on next pages.

Camera and UHF cable TV modulator used for Simplex ATV



Cable from camera has video (yellow RCA connector) and audio (black RCA connector). Powerpole connector on end of power cable for modulator (significant is this unit only needs 12VDC). Modulator shown is the Vecima model purchased from charleslidstone.com although no longer available, this shows effective packaging using direct power cable with powerpole (DC inline power receptables unreliable for field use), F-connector to RCA adapters, and F-connector to BNC to make use of a 1/4 wave antenna. Fast and easy field ATV transmitter!

Camera and 1.2GHz transmitter used for Simplex ATV

Packaged inside black box is a Mobicomm 1.2GHz transmitter board. RCA connectors for video input (yellow) and audio input (black). Powerpole connector for 12VDC.

Mobicomm, ebay seller ID gnupic, transmitter is a single circuit board with appropriate connectors. For field use, I recommend a package as shown above. Video and audio connectors can be mounted on top but should be readily available like antenna mount (an sma receptacle). Another recommendation is a cord with powerpole instead of typical DC power inline connectors which are not reliable for field use. Less detachable cables means less chance of forgetting something behind.

Examples of ATV Reception

Actual received amateur television transmissions using consumer cable-ready TV sets

ATV demo during Ames Emergency Prepardness Fair in 2007

ATV reception using portable (12VDC) TV set

Demo of K6BEN ATV repeater during Ames 2003 Airshow

ATV in use at SVECS breakfast meeting, note J-pole on right for receiving antenna

ATV is *NOT*

- Cellphone cam or webcam
- Bluetooth, PDAs, Blackberries, etc.
- WLAN, WIFI, or Internet related
- Broadcast TV, Cable TV, Satellite TV
- Activity available only to the very rich

What kind of TV programs?

- Anything you want in the spirit of amateur radio.
- Experiment, show your friends, try new designs, etc.
- Televise club meetings.
- NASA-TV retransmission (Space Shuttle, ISS).
- Televise techie activities from the field
- Televise parades, public events in support of ARES/RACES.

Real television! Same technology, different frequencies and applications

FCC Part 73 Broadcast: Entertainment, advertisements, paid programming
FCC Part 97 Amateur: Experimentation, hobby, ARES/RACES, cannot make money
"Amateur" is a legal term meaning compensation free.

ATV transmits over a wide area but transmissions should be directed toward other hams, not general public (that is what Part 73 broadcast services do). Though it is possible general public can tune their TV sets to view hams like using a scanner to listen to hams on 2m or HF.

ATV Benefits

- ATV enables hams to impress their friends with technical prowess.
- ATV provides direct hands-on experience in transmitting television.
- ATV is independent of Internet, networks, centralized systems, and cable TV.
- ATV is independent of media companies, government agencies and budgets.
- ATV is independent of subscriber fees, codecs, TCP/IP addressing, software licenses, …

Getting started in ATV

- Get a cableready TV set or VCR (channels 57, 58, 59, 60 are in 70 cm band)
- Commercial video modulators can be used for lowpower 70cm transmitters
- 70 cm (UHF) ATV transmitter from PC Electronics or "allgizmo" (ebay seller)
- 900 MHz, 1200 MHz, or 2400 MHz transmitter and receiver boards from Mobicomm (gnupic on ebay) or Comtech (ATVQ magazine)

Save those old VHS VCR recorders!

Most are cableready and make excellent UHF ATV receivers. They have video outputs for monitors, better sensitivity than most TV sets, and can record ATV events.

Why more CATV channels than broadcast TV channels?

- CATV uses frequencies of other radio services, as long as it stays inside the cable!
- These frequencies include amateur radio (i.e. cable channel 58 is 427.25MHz)

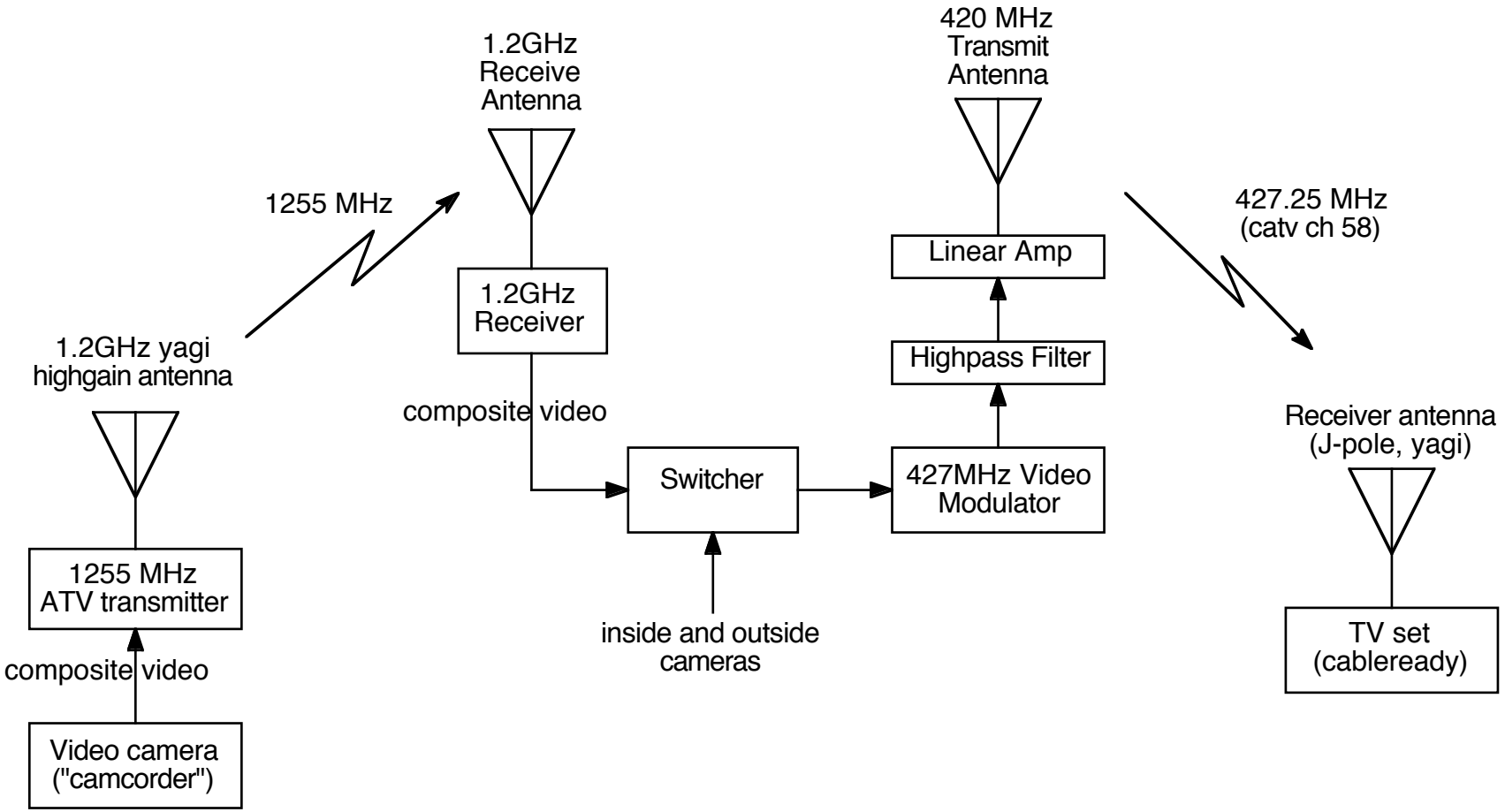
ATV Frequencies in Reference to Broadcast and CATV Frequencies

Broadcast TV*				Cable TV			
CH	BAND	VIDEO	AUDIO	CH	BAND	VIDEO	AUDIO
2	54- 60	55.25	59.75	2	54- 60	55.25	59.75
3	60- 66	61.25	65.75	3	60- 66	61.25	65.75
4	66- 72	67.25	71.75	4	66- 72	67.25	71.75
14	470-476	471.25	475.75	14	120-126	121.25	125.75
15	476-482	477.25	481.75	15	126-132	127.25	131.75
57	728-734	729.25	733.75	57	420-426	421.25	425.75
58	734-740	735.25	739.75	58	426-432	427.25	431.75
59	740-746	741.25	745.75	59	432-438	433.25	437.75
60	746-752	747.25	751.75	60	438-444	439.25	443.75
82	Cellphones and 2-way radios			82	570-576	571.25	575.75
83	Cellphones and 2-way radios			83	576-582	577.25	581.75
84	none			84	582-588	583.25	587.75
85	none			85	588-594	589.25	593.75

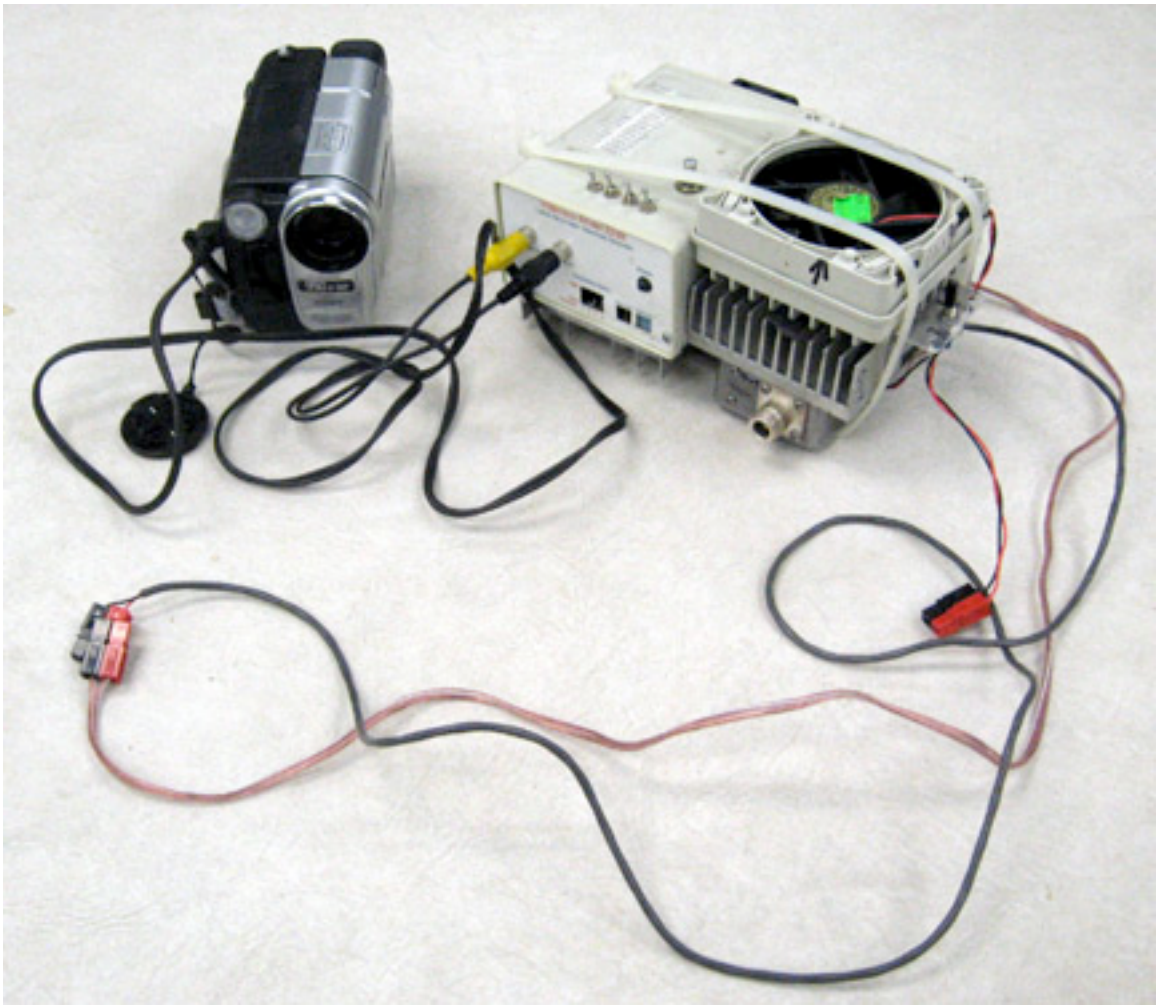
*OTA broadcast is now DTV, there are no center video and audio freq, these frequencies are shown as many legacy systems still exist.

Complete list of NTSC frequencies:
http://www.svecs.net/ntscfreq.html

K6BEN: South Bay's Amateur Television Station



Camera and 1.2GHz transmitter used for K6BEN Repeater ATV



Videolnyx 1.2GHz transmitter on left, Downeast Microwave 1.2GHz linear amp on right. A cooling fan is used on the linear amp, powerpole connectors for 12VDC to Videolnyx, RF linear amp, and cooling fan.

ATV in the Field

- Transmitting from field is more exciting and interesting than from a ham shack
- Equipment (transmitters, TVs, cameras) should be 12VDC devices.
- For AC inverters, use smaller units i.e. 100 watts maximum.
- Field kits should be simple enough for any reasonable amateur radio person to operate, and quick to setup or delegate tasks (someone to deploy cables, another to raise antenna, one to connect power sources, etc.).
- Highly specialized systems prevents ability to delegate.
- Batteries, batteries, batteries,… you must have plenty of batteries to maintain operations.
- Be prepared to carry lots of equipment long distances on foot, probably multiple trips.
- Most important for ARES/RACES events is to know what to view and from where. It is not what is good for you, it is what emergency managers (fire, police, EOC) want.
- ARES/RACES footage is boring (view of bridges, rivers, overview of disaster scene), it is not entertainment, but there are serious viewers (emergency managers).

ATV Transmitters

Bands to consider:

- UHF (70cm) to transmit directly to cableready TV sets (421, 427, 434, 439 MHz)
- 900 MHz, becoming more popular
- 1.2GHz (23cm), transmit to K6BEN repeater
- 2.4GHz (13cm), same band with Part 15 wireless video monitors

RF Transmission Cable… very important

- Use the highest of quality lowloss coax.
- Cheap cable WILL NOT work. Don't use RG-8, RG-58 except patch cables
- Recommended cable is Belden 9913, LMR400, Heliax.
- Lowloss cable is absolutely a must for 1.2GHz and 2.4GHz including receiver use

Cameras

Any camera with composite video output with 12vdc capability, no need to send sound

- Camera with 12VDC adapter. If no 12VDC adapter, use a small inverter for efficiency
- Camera with built-in titlemaker and is not "auto shut-off" a real plus
- A recommended camera is Sony TRV-138, $215 from B&H Photo or BestBuy

Don't forget a tripod for the camera! Most ATV events use stationary cameras.

420MHz, 70cm UHF Transmitters

main advantage is consumer TV sets (cable-ready) can directly receive transmissions

Amateur TV Transmitters:

- RTX70-1 (1w crystal controlled), $300 from PC Electronics, http://www.hamtv.com
- VM-70X (5w 4-channel), $200 from VideoLynx, buy from PC Electronics
- Z70A Mini (100mW 4-channel), $150 from VideoLynx, buy from PC Electronics

Ready to use with reasonable amount of RF power, disadvantages are DSB (both sidebands require more than 6MHz of spectrum) and have a lot of splatter.

Video (CATV) modulators. These are VSB and do not interfere with lower frequencies.

Search used markets, i.e. ebay, because new from manufacturers are expensive

- Drake VM2551 Agile Commercial Video Modulator ($600 new)
- Drake VMM860AG Mini Video Modulator (a few hundred dollars new)
  R.L. Drake (www.rldrake.com) is a well known manufacturer of CATV modulators
- CATV Channel Modulator on ebay by seller “allgizmo” ($80)
- Used modulators at http://www.charleslidstone.com/for_sale/A2020/ (probably sold out)

Modulators have superior video quality, very low outside-of-band interference, some are 12vdc, many are frequency agile. Disadvantage are low power, RF amps need to be very linear.

Linear amps must be class A type (do not want distortion) for television transmissions.
Downeast Microwave, 7025PA (35W), $210, www.downeastmicrowave.com (long lead times)
Mirage Amplifiers, D-1010-ATVN (50W) $440, http://www.mirageamp.com

900 MHz Transmitters and Receivers

Used to be popular until it was overrun by Part 15 devices, but now is becoming renewed interest as many Part 15 services migrated to 2.4GHz.

Easier to find commercially produced antennas and smaller size than 70cm antennas.

MobiComm Communications (Netherlands) on ebay, Seller ID: gnupic
- 2 Watt 915 MHz ATV FM Video Audio Transmitter, $135
- 915 MHz ATV FM Video Stereo Audio Receiver, $90
- 2 Watt 900 MHz ATV Video Package deal, $220

Comtech http://comtech.hampubs.com
- 40mW 900 MHz and from 1.2 GHz FM ATV transmitter, $70
- 900 MHz and from 1.2 GHz FM ATV receiver, $70

RF amp and receiver preamps from Downeast Microwave at http://downeastmicrowave.com
- 900MHz linear amp 3340PA (40W), $235
- 900MHz DEM 33LNAWPQ - 33cm ATV Low Noise Amplifier, $120

Verify these will work for ATV (Downeast has very long lead times)

Most ATV transmitters and receivers will need to be packaged for easy field use: Container box with antenna connector, RCA jacks, powerpole connections

1.2GHz Transmitters and Receivers

Warning!

- Verify 1.2GHz transmitters operate only on amateur radio frequencies.
  Never buy anything else, most likely operates on aero-navigation frequencies
- If company or dealer cannot say exact frequency, then illegal to operate

1.2GHz used for uplink freq of K6BEN and W6CX repeaters. But Wyman and Videolynx transmitters are no longer available (which is why no new ATV participants in recent times).

MobiComm Communications (Netherlands) on ebay, Seller ID: gnupic

1 Watt 1.2GHz FM ATV transmitter, $130
1.2 GHz FM ATV receiver, $90 (may need a preamp)
1 Watt 1200 MHz FM ATV Video Package deal, $220

Comtech http://comtech.hampubs.com

40mW 900 MHz and from 1.2 GHz FM ATV transmitter, $70
900 MHz and from 1.2 GHz FM ATV receiver, $70

1.2GHz systems from www.hamtvstore.com ATVQ magazine says it is a scam site.

RF amp and receiver preamps from Downeast Microwave at http://downeastmicrowave.com

1.2GHz linear amp 2330PATV (30W), $240
1.2GHz receiver preamp 23LNAWPQ LNA $120

Verify these will work for ATV (Downeast has very long lead times)

- *Never Purchase or Use 1.2GHz That Do NOT List Actual Transmit Frequencies*
  Many sold on ebay, internet, Pacificon, etc. These transmit 1000 to 1180MHz aeronautical navigation (transponders) so don't contribute to knocking an airplane off course.

2.4GHz (13cm) 2300-2310 MHz, 2390-2450 MHz

Very common and compatible with Part 15 wireless video systems which are low cost. Disadvantages are excessive number of license-free devices besides video (microwave ovens operate at 2.450GHz), and extreme frequencies are mostly for point-to-point.

DFM2350TSIMP-WB, 200mW transmitter, $100 from Mobilcomm
DFM2400RTIM-B receiver, $80 from Mobilcomm
X10, Swan wireless cameras at Frys, baby monitors, etc.

Generally, this is a crappy band…

There are many Part 15 devices (lowpower, no license required) that operate on 5.8 GHz, these may become more common as consumer market increases use of 5.8 GHz devices.

Antennas, Cables, ID Overlays

Antennas should be small for easy transport and setup, but “big” enough for RF gain.

- Small yagi antennas
- UHF J-pole, $25 from SVECS breakfast meetings and DeAnza electronics flea market
- Dualband VHF/UHF J-pole by Edison Fong WB6IQN, $20 from HRO
- Comet 1216E 1.2GHz multiple element yagi, $150 from HRO

Antenna tripod MFJ-1919, cost $80 from HRO.
MFJ-1919 is superior to ChannelMaster tripods. Lightweight, no tools required, more stable, etc.

Use the highest quality coax, i.e. LMR400 or 9913F. Do not use RG-8 or RG58.

Onscreen Titles, FCC requires callsign displayed, easiest to use are onscreen displays:

Intuitive Circuits onscreen displays: OSD-ID-SA $120, http://www.icircuits.com

Jameco Electronics XBOB-NC video text module $190, http://www.jameco.com

ATV Receivers

Cable ready TV sets that are direct tune, not autotune.

Do not use “downconverters” for 70cm (not needed) unless for 900 or 1200MHz.

Ideal receivers are with built-in VCR to record events as needed.
Avoid DVD recorders (not reliable)

Stores sell new TVs that are digital. Analog only no longer available

roadtrucker.com has products to operate on 12VDC including cableready TV sets.

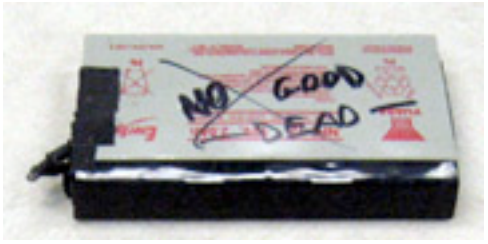
For 900 or 1200MHz, refer to products listed in previous slides.

Will need some kind of TV or video monitor with a composite video input.

Single Point Failures!

Lose one of these items and it is loss-of-mission for ATV in the field

Everyone grabs the big items (camera, transmitter, antenna)
but many times small stuff like these gets overlooked.



Insufficient battery(s) or battery has no connector

Video adapter cable from camera

"The Special Connector"
A classic example is using that "special" antenna
for ATV with uncommon connectors, and you are
stuck in the field with antenna, coax, and transmitter
but you don't have that N-to-PL-259 adapter.

Digital Television (DTV)
(sorry no experience with this mode)

The Big Transition of 2009 applied only to commercial broadcast, hams can still use analog.

Future of ATV regarding DTV transition? Not immediate but few years there will be an impact in terms of usable equipment and a decreasing lack of techie know-how in America.

Most likely will never be Part 97 "amateur" gear (mpeg is a proprietary format)

Commercial DTV modulators may be utilized, but not cheap (there are no "consumer" modulators)

DTV signal uses "more" of spectrum as compared to analog NTSC. 6 MHz of spectrum is assigned to analog NTSC but it's AM carrier is relatively small portion of that 6 MHz. Digital ATSC transmission is a solid 6 MHz signal, however European DVB uses 2 MHz.

An educational to see what the spectrum looks like (vs artwork) where N6QQQ "tours" TV broadcast spectrum with a spectrum analyzer just before the DTV transition, we can see how ATSC compares to NTSC at http://www.youtube.com/watch?v=DwECu6ljhmk

Digital satellite, digital cable TV, and digital OTA are all different. Can no longer do direct receive using consumer TV sets, must use "down-converters."

Nick N6QQQ has done experimentation with ATSC transmissions on UHF ham band, with a tour of ATSC transmitting gear at http://www.youtube.com/watch?v=q0ky-tUrveI using systems from http://www.sr-systems.de

Nick has additional info at his site, http://www.n6qqq.org and http://www.youtube.com/user/nsayer

Local ATV Groups

Your first and fastest way to get into ATV is jump into a weekly net!

Silicon Valley ATV Group - K6BEN
http://www.mfwright.com/k6ben.html
http://www.k6ben.com (graphic intensive)
Input 1255 MHz video, output 421.25 MHz (cable ch 57) NTSC video
Voice input 145.510 Mhz simplex
K6BEN video weekly net, visitors welcome, every Weds at 8:30 pm
Can also check in audio on 145.510 MHz simplex or 443.125+, PL123.0

Mt. Diablo W6CX ATV (Contra Costa Co.)
http://www.mdarc.org
Input 1289.25 MHz video, output 910.25 and 1241.25
W6CX video weekly net, Thurs at 8:00 pm, audio on 147.060+, PL100 MHz

Stanford Amateur Radio Club - W6YX probably not active
http://www-w6yx.stanford.edu/w6yx/
2433.75 MHz (X10 channel B)

Amateur Television (ATV) Info

Amateur Television Network (ATN)	http://atn-tv.org
Amateur Television Quarterly (ATVQ)	http://www.hampubs.com
Amateur Television Directory	http://www.qsl.net/atn/atv-tv.org

NASA-TV retransmissions from Ames Amateur Radio Club to K6BEN:
http://hamradio.arc.nasa.gov/AARCatv.html

Foothills Amateur Radio Society July 24, 2009 meeting:
http://www.fars.k6ya.org/docs/FARSATVpresentation.pdf

ATV presentation at SARA in 2008:
http://www.k6sa.net/media/SARAATVpresentationRev2.pdf

ATV presentation at SVECS in 2007: http://www.svecs.net/ATVpresentation.pdf
updated version http://www.svecs.net/ATVpresentation3-9-11.pdf

Lots of ATV links to sites, equipment, etc., http://hamradio.arc.nasa.gov/amateurtv.html

My personal ATV page at http://www.mfwright.com/atvsetup.html

My youtube page with ATV clips at http://www.youtube.com/user/k6mfw

ATV on dxzone.com:
http://www.dxzone.com/catalog/Operating_Modes/Amateur_Television/index.shtml