

# Getting Started in VHF/UHF Weak Signal Operation

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# Overview

- I've enjoyed 6 Meter Sporadic E (Es) operation for many years
  - Simple antennas and low power works fine
  - I had the best luck with a 3 element Yagi and 100W
  - Es reflections are less lossy than f-skip
  - I've had many double hop contacts to Florida
- Most modern HF radios include 6M
- Es operation is exciting due to its semi-random occurrence
  - Peak season is May-July
  - Secondary peak in December
- Sporadic E can also extend into the higher HF bands like 10 and 15M
  - It extends up to 2M occasionally as well
- This got me thinking about weak signal operation on 2M

# Pandemic Project

- I was thinking about new things to try while stuck at home. I decided to try building a 2M Yagi using the “Cheap Yagi” plans provided by WA5VJB
- I chose a 6 element version to limit the boom length. I used PVC pipe and #8 copper ground wire.
- The antenna is mounted on my roof up about 25’ and is turned with a TV style rotor
- It worked very well during several VHF contests which were a fun diversion
- Now I wanted to learn more about VHF propagation



# 2M Weak Signal Operations

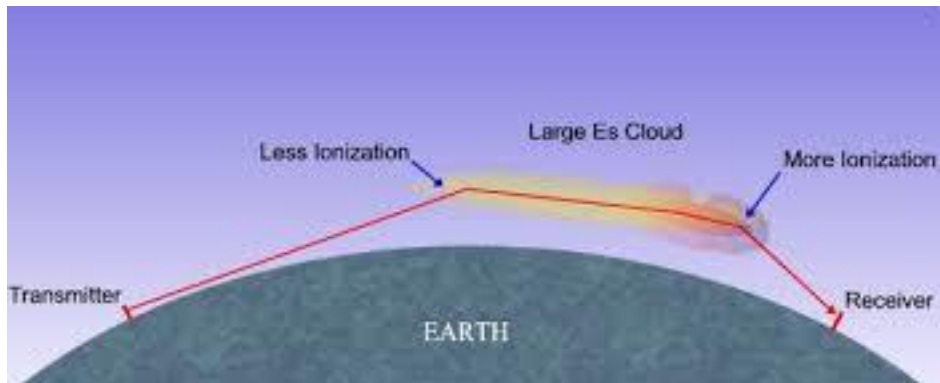
- 30 years ago there was a lot of VHF/UHF weak signal activity
  - Weak signal comprises CW and SSB for purposes of this presentation
  - Digital modes are popular and require less power than the traditional modes
  - There are many propagation modes used on VHF
- Propagation modes include:
  - Troposcatter
  - Aurora
  - Tropospheric Ducting
  - Es
  - F<sub>2</sub> layer
  - Meteor Scatter
  - Moon Bounce



# Primary 2M Propagation Modes

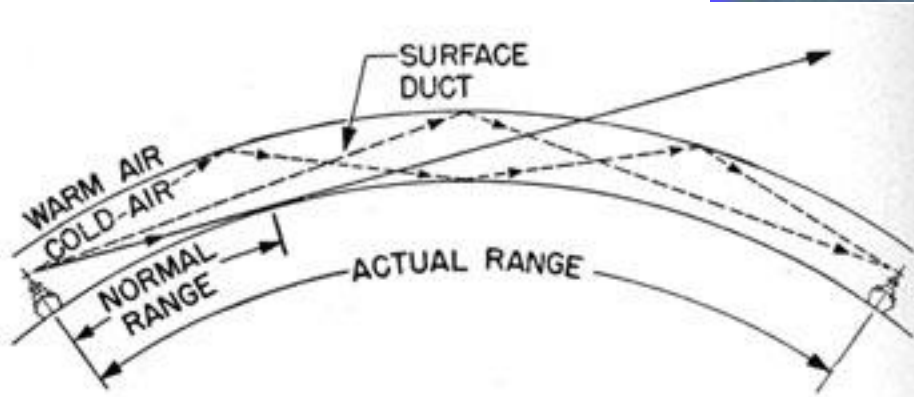
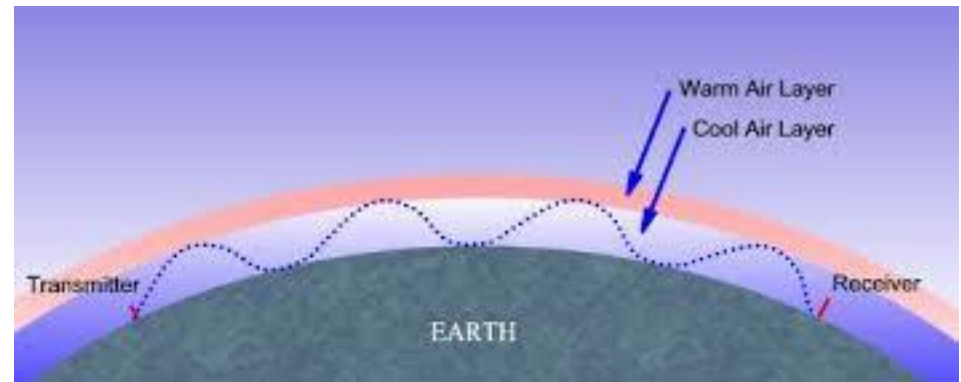
- Troposcatter
  - Most routine VHF comm is Troposcatter
  - Differences in air pressure/density scatter the wave ever so slightly
  - A big Yagi and a brick amplifier are needed for reliable distant communications
- Tropospheric Ducting
  - Caused by temperature inversions
  - Common between CA and HI (also San Diego and Los Angeles)
  - Most common in spring and fall
  - Beginners station is a 5-10 element Yagi 20-30' high and 100W
- Es caused by a heavily ionized cloud at E-layer height (60-70 miles)
  - Poor correlation to sunspot numbers
  - Duration in minutes to hours, location unpredictable
  - Beginners station is a 3 element Yagi @ 35' and 100W
- $F_2$  is sunspot cycle dependent, best at peak of cycle

# Propagation Modes



Sporadic E

Tropo Ducting



Tropo Ducting greatly enhances propagation. Ducts from Los Angeles to Hawaii are common. Ducts from LA to San Diego happen often.

# Primary 2M Propagation Modes – cont'd

- Meteor Scatter
  - Major showers are predictable
  - Random Meteors best in the mornings
  - Short sequences
  - Equipment required is the same as Troposcatter
- Moon bounce
  - Until recently a big antenna array and power amplifier were required for EME
  - Today a modest station using one of the new digital modes like JT65 is typical
- Aurora
  - Not useful from lower latitudes

# 6 Meter Meteor Scatter

- Always present but peaks June, July and August
  - Best 5 days before to 5 days after one of the big meteor showers
  - 6-10AM is best
- Mostly digital modes
  - WSJT MSK 144 mode
  - 50.260 MHz calling frequency
  - Send message 15 sec, then listen 15 sec
  - Contact sequenced by software
- Set up schedules using PING Jockey
- 100W, 2-5 element Yagi
  - Tilting the Yagi up 15 degrees helps
  - 400-800 mile range



# Calling Frequencies

- Calling frequencies are used to start a contact. Lengthy discussions should be done on another frequency
  - One of the established FM simplex frequencies
  - Any frequency in the appropriate SSB band segment
- FM Simplex Calling Frequencies
  - 6M        52.525 MHz
  - 2M        146.52 MHz
  - 70cm      446.00 MHz
- SSB Calling Frequencies
  - 6M        50.125 MHz
  - 2M        144.20 MHz
  - 70cm      432.10

# Station Equipment

- You will need a transceiver that works on SSB and CW on the VHF bands or a transverter to convert an HF transceiver signal to VHF
- Low power transceivers like the FT-817/818 or IC-705 can be used with an external amplifier
- Low-cost HF-VHF-UHF transceivers are very popular
  - FT-991A
  - IC-7100
  - FT-857



# Base Station Radios

- VHF/UHF base station transceivers
  - IC-9700
  - IC-910H (discontinued)
  - TS-2000 (discontinued)



IC-9700

2 Meter Transverter



# Station Equipment – cont'd

- There are older designs that may be good values in the used market
  - May not be supported by the manufacturer any more
  - Some are single band radios
- Avoid tube radios, they are too old and difficult to maintain
- Transverters:
  - Q5 Signal (Down East Microwave)
  - SSB Electronics
- Other equipment:
  - Antenna rotator
  - Antenna mounted preamp if you have a long coax run

# Antennas – work in progress

- I had trouble finding useful information on antenna needs
  - For 2 meters a Yagi with 12-15dBi gain is suggested. Boom lengths are in the 12-15' range
  - I'm not convinced this is really required to see if you like weak signal operating. A 4-5 element Yagi on a 6' boom is probably adequate. A WA5VJB Yagi is good for starters.
  - Cubex has an 8 element Quad with 14dBi gain on an 8' boom
- For 70cm a higher gain antenna is desirable since the capture area is smaller at that frequency. A 22 element Yagi was suggested in one article I read.
- Antenna heights of 30-35' are typical for good performance
  - 35' is considered optimum for Es
- Plans for homebrew Yagi's can be found at [WA5VJB.com](http://WA5VJB.com)
- Stacking a 2M Yagi over a 6M Yagi requires a 5' spacing
- Use low loss coax like LMR400
- 150-200 mile range on 2M and 70cm bands
  - Lower antenna gain means less range

# VHF/UHF Antennas

4 x 6 elements Yagi PA144-6-2  
OZ1BXM 2017



# VHF/UHF Contesting

- Contesting on VHF/UHF has always been popular
- The big contests are:
  - ARRL in January, June and September
  - CQ in July
- There are also Sprint and local contests
- There was a very good article in the National Contest Journal May/June 2019 issue on setting up a VHF/UHF contest station
- Many hams enjoy being rovers, operating from rare grid squares. They often have impressive antennas and change locations
  - Some do this to avoid HOA restrictions
  - Most, I suspect, simply enjoy operating portable and building antennas
  - Some just like to attract attention while driving on the freeway
- Awards are available for working grid squares (VUCC), this is a popular activity. Many contest OPs are award hunters too

# Rover Operation

- This looks like a lot of fun to me, a dedicated “non-contester”
  - Rovers operate from rare grid squares and often move around during a contest
- Starting out with 6M, 2M and 70cm would be very easy using a radio like the FT-991A or IC-7100
- Antennas vary from simple Moxon’s (2el folded Yagi) on 6M to long boom Yagi's on the higher bands





# Summary

- This presentation is a “work in progress”. I’ve spent many hours on the internet trying to find useful information
- I also reviewed every “World above 50 MHz” column in QST from 2008 to the present. They are focused on propagation, which is very significant
  - The November 2019 column describes an attic installation caused by an HOA restriction that was interesting
- I wrote to Steve Ford, WB8IMY, the publications manager at the ARRL and suggested they consider publishing a book on VHF/UHF operating. He liked the idea.
- I found a useful book: *VHF, Summits and More: Having Fun With Ham Radio*, by Bob Witte, K0NR
- One of the salesmen at HRO Anaheim is active on VHF weak signal, he suggested the Cubex 8 element Quad for 2M

# Closing Remarks

- I had a lot of fun pulling this information together. I learned a lot about a wide variety of VHF/UHF activities
- I don't want to spend my hobby money on activities that have low participation, even if they look like a lot of fun.
- I built a 6 element WA5VJB Yagi using PVC pipe and #8 copper wire for <\$20. I have it mounted at about 30' using a cheap TV style rotor. It works very well.
- I'm using a FT-991a
- I've been checking into the 2M West Coast BOZO net
  - <http://wiki.yak.net/1109>
- There are many 2M OPs in So California
- I had fun operating in the ARRL June 2020 VHF Contest. It was very low key compared to HF contests.