

# Portable and Mobile Operation

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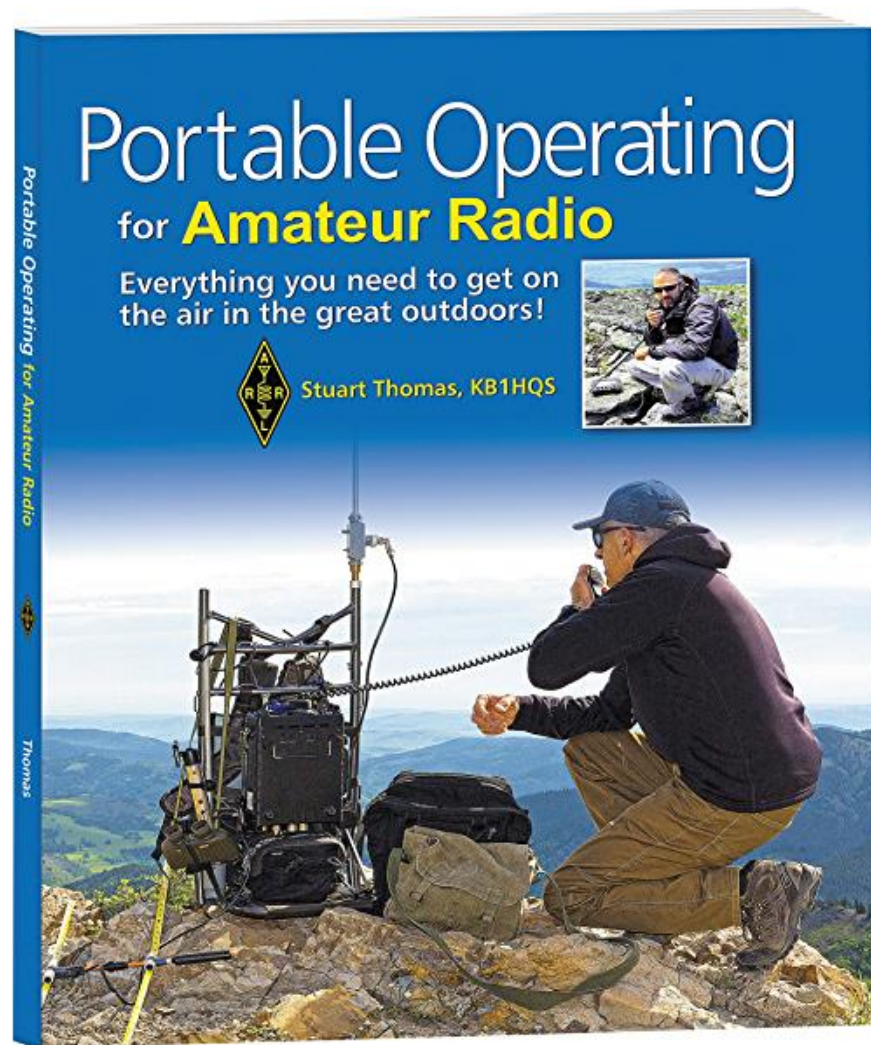
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# Introduction

- I got into mobile and portable operation to allow me to operate during family activities
  - Long drives to vacations or camping
  - On vacation, while camping
  - Weekend kids' sports trips
  - Commuting
- I operated HF 40-10M CW usually at 50W in a big van
  - Spider multi-band vertical
  - Ham Sticks
  - Custom built radio rack with an arm rest to hold my key
  - Beginners radio, like an IC-718
    - Big display
    - Simple to operate
- I also had VHF/UHF FM

# Why Operate Portable?

- HOA restrictions limit home operation
- Less noise away from the city
- Vacations and travel
- Hiking
- Just for fun



# Getting Started



- What bands do you want to operate?
- Mobile or portable or both?
- What is your budget?
- HF Portable has a lot of options
  - I suggest 50-100W during this part of the solar cycle, especially for SSB
  - There are many small radios with very good performance
  - Antennas are easy to build to get started
- HF mobile requires more thought
  - A mobile antenna can also serve as a portable antenna
  - CW requires advanced operating skill
  - SSB is common on 20/40M now, 10M during good solar conditions
  - Some operators report noise levels too high near big cities.

# Portable Operation

- I prefer operating while stationary
  - Safety
  - More antenna options
- At this point in the solar cycle QRP is very frustrating. I suggest 50W as a good compromise, especially if you operate SSB.
  - Some portable antennas have low max. power limits
- An HF mobile antenna like a Ham Stick can be attached to the car in a few minutes. I use a Mag mount.
- A portable wire antenna using a telescoping mast or pole can be erected in 5-10 minutes with a little practice.
- A short vertical can be attached to the radio, mounted on a tabletop tripod or clamped to a picnic table
  - Two elevated radials will provide good performance
- A small loop can be mounted on a tripod in under 5 minutes

# Transceivers

- I still recommend 50-100w for beginners, especially for SSB
  - FT-891
  - IC-7300
  - IC-7100 (includes VHF/UHF)
  - FT-991a (includes VHF/UHF)
  - TS-590sg
  - FTdx10 - New
  - QRP rig with an amplifier
- You can always turn the power down to operate QRP
- We are fortunate to have several very good, small Low Power multi mode radios available
  - Elecraft KX2 and KX3 (12 & 15W)
  - FT-818 (includes VHF/UHF) (6W)
  - IC-705 (includes VHF/UHF) (5/10W)
  - XIEGU G90 (20W)(TX not clean in QST review)
  - Lab599 Discovery TX-500 (10W)(Weather resistant)

# Decisions, Decisions – 50-100W Operation

- If you have a transceiver favorite brand stick with it
- If you want to mount it in the car for mobile while driving a removable head is nice to have
  - FT-891
  - IC-7100
- I use Ham Stick style antennas mounted to my Outback with a mag mount
  - MFJ-16xx cost about \$22/band at HRO
  - Good performance on 20-10M, quick assembly, ~7' tall
  - Can be mounted on a tripod with radials too
- When I'm away from the car I use a BuddiStick on a 3' tripod with 2 wire radials
  - Packs up small
  - Good performance
  - 40-6M
  - Super Antenna MP-1 is easier to QSY (40-10M)

The majority of POTA operators use 50-100W. *Life's too short for QRP*

# Decisions, Decisions – Low Power Operation

- For ultra portable operation you have more decisions to make
  - Smaller, less capable radios are available. CW only radios are small and consume less battery power.
  - The New IC-705 looks like a terrific radio.
    - 2.2#, all mode, HF/VHF/UHF, nice spectrum display
    - Higher DC power, not excessive
    - No internal ATU
    - 5/10W output (5W on internal battery)
  - My favorite KX2 is a very good performer
    - 13oz, all mode, wide range ATU
    - Lower DC power
    - No spectrum scope
    - 10/12W output
    - I typically get 4 hours on the internal battery @ 10W
  - I think the IC-705 is a great picnic table radio. The KX2 is better on longer hikes



- There are too many antenna variants to be presented here
  - Bring a dipole and a vertical with you



# Antenna Summary (Typ. 20M)

Antenna	Install Time	Relative Gain	Notes
$\lambda/4$ Vertical	15-20 minutes	0dB	2-4 elevated radials
Hamstick on car, Mag Mount	5 minutes	-1dB	Separate antenna for each band
BuddiStick, Tripod, 2 radials	10 minutes	-1dB	Change bands in 5 minutes
MFJ 1820 vertical 2 radials	5 minutes	-6dB	Separate antenna for each band
Elecraft AX-1 2 radials	5 minutes	-6dB	Tuner required
Dipole/Inv-V EFHW	15-20 minutes	+6dB	Mast/support required
Small Loop on tripod (36")	10 minutes	-6 dB	Tripod required, tune 40-10M

# Antennas – cont'd

- The Antenna Summary table is based on my field testing plus analysis. Any of these antennas will work if band conditions are good
- A location on a slope to the East is best
- I suggest starting with a home brew wire antenna or low-cost vertical/whip
  - They are proven performers, and you won't spend a lot of money in case you don't like portable operation
  - A 20' push up pole will support a 20M vertical wire or dipole
- I've noticed a disturbing trend regarding portable antennas: More models are being introduced (Good!) and some of them carry high price tags (Bad!)
  - The IC-705 is already causing new developments
  - Good performing portable antennas are cheap and easy to build yourself
  - *You don't need a \$500 antenna to have fun with portable operation. Don't be fooled by marketing hype*
- PackTenna sells very well-made wire antennas and accessories good to 100W for a reasonable cost if you don't want to make your own

# Antennas – cont'd

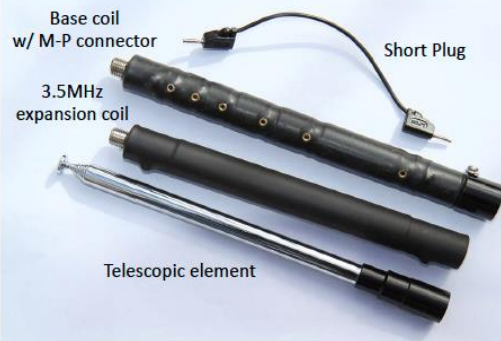
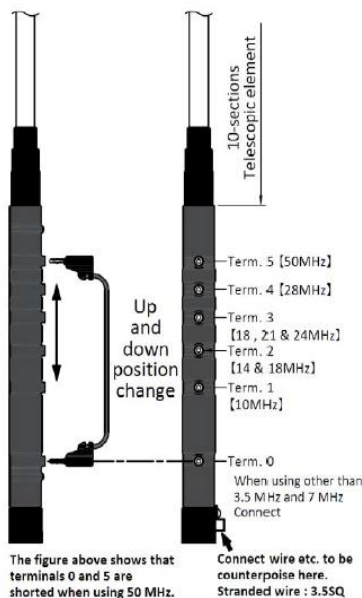
## HFJ-350M

3.5-50MHz 9-Bands  
Portable  
Telescopic Antenna

- It is a 3-division structure that is convenient to carry.
- Telescopic antenna for multi-band HF to 50 MHz band, whose frequency can be easily changed by short plug.
- $1/4 \lambda$  base loading type antenna.



**This antenna is recommended to use counterpoise and antenna tuner.**



### 【 Specifications 】

Frequency : 3.5 - 50 MHz    9-Bands  
Max.Input Power : 75W (SSB) [3.5MHz]  
100W (SSB) [7-50MHz]  
Impedance : 50Ω  
Length : Min. 370mm , Max. 1610mm  
Weight : approx. 245g  
Antenna Connector : M-Plug

This Comet multi-band vertical caught my eye. At \$120 it is a very flexible antenna. You only need to carry one unit to cover multiple bands. Its probably poor on 40M, but as good as the MFJ or Elecraft whips.

The HFJ-350 is a perfect companion for a KX2/KX3, FT-818 or the new IC-705. It even has a counterpoise (Radial) lug on it. It is ~5' tall so its best when mounted on a tripod

The slightly larger BuddiStick has 1 S-Unit more gain for \$139.

# Interesting Portable Antennas

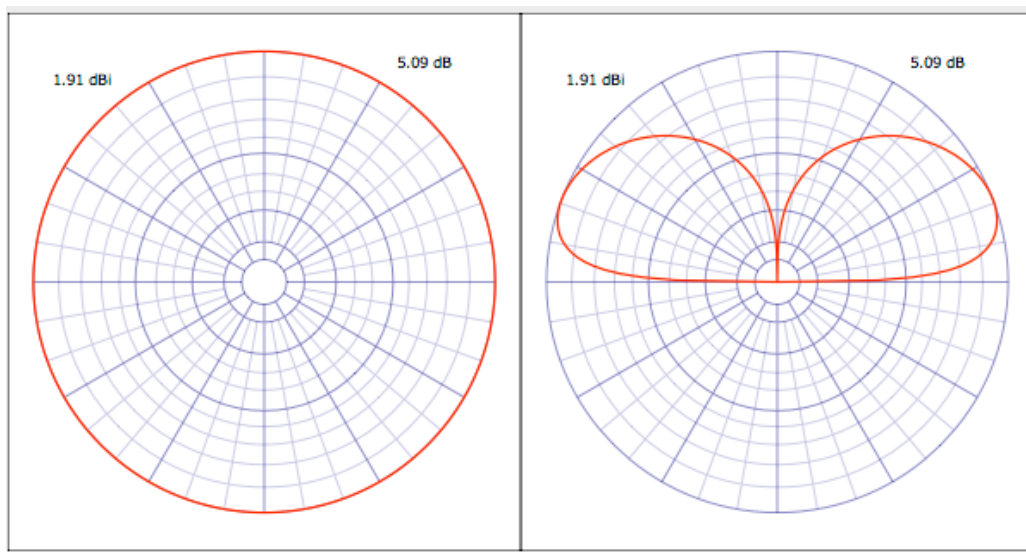
- A 21' Black Widow style fishing pole can be used to support a 17' wire which is a full  $\lambda/4$  vertical on 20M. Two  $\lambda/4$  elevated radial wires complete this efficient 20M antenna. Total cost is <\$50 without a base support.
- For those who prefer not to build things, MFJ makes a Big Stick vertical that consists of a 17' telescoping whip radiating section, radials and a coil which provides resonance on 40M. Cost is ~\$120. They also make a dipole version called a Big Ear for ~\$180. Base support not included.



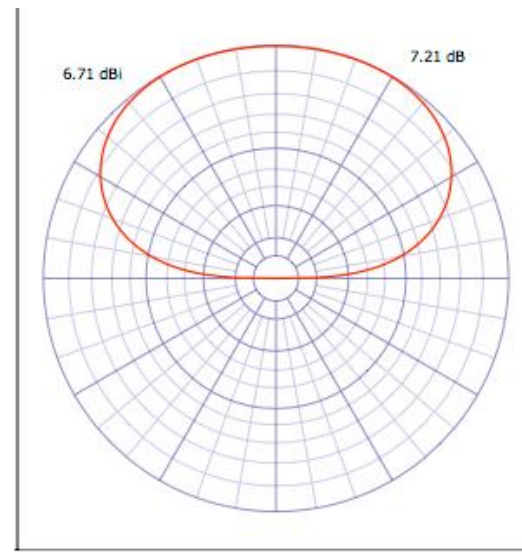
# Short Vertical Performance – Deep Dive

- The July 2020 issue of QRP Quarterly had reprint of a great review article on verticals by L. B. Cebik, W4RNL (SK)
- It reminded me of some analysis I did several years ago to validate some on the air test results
- First off let's compare a vertical with a low dipole:

Vertical on Ground



Low Dipole



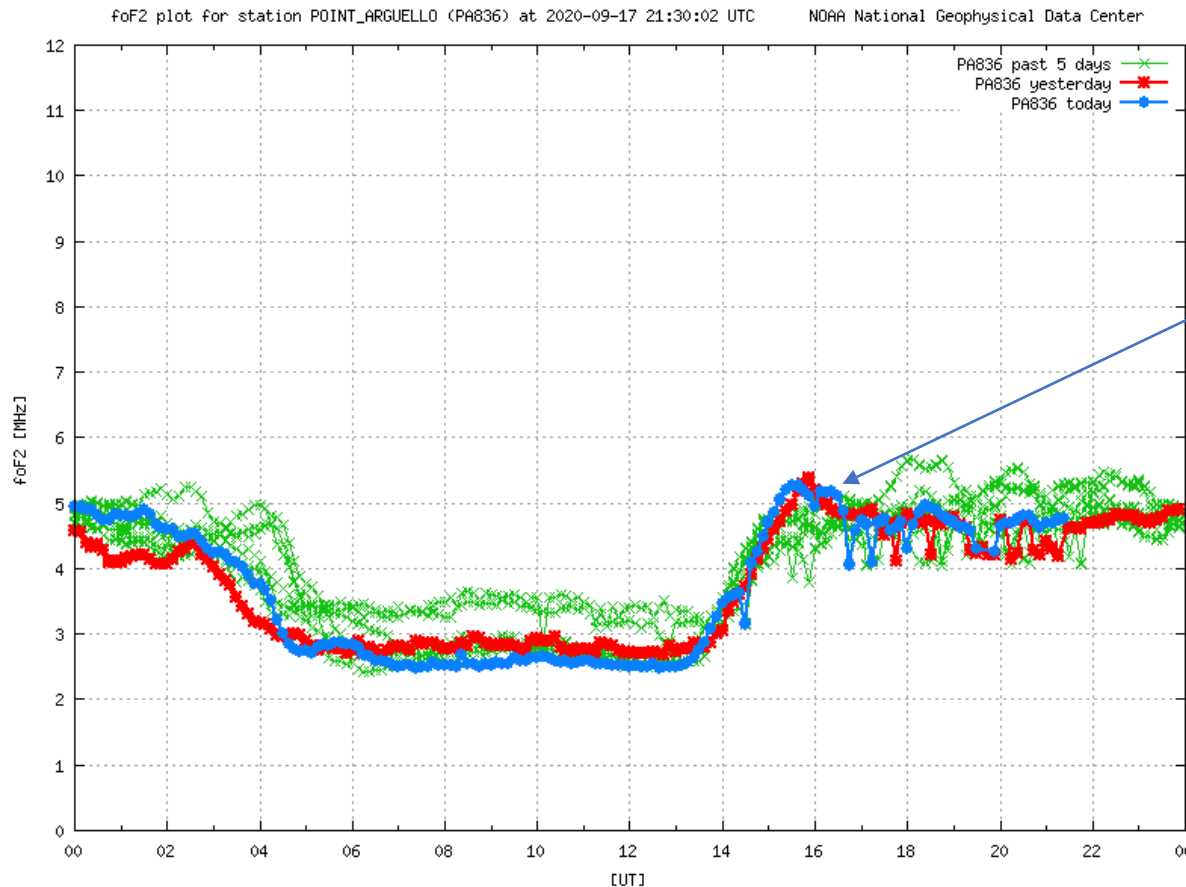
# Skip Distances

Radiation Angle (degrees)	Single Hop Distance (miles)		Antenna Gain (dB)	
	f1 layer	f2 layer	Vertical on Gnd	Dipole @ $\lambda/4$
5	1200	2300	-2	-8
10	800	2000	1	-3
20	500	1200	2	2
30	300	800	2	5
40	240	650	0	6
50	200	500	-2	7
60	200	400	-4	7

Verticals are best for contacts >1000 miles away  
 Dipoles are best for close contacts, <1000 miles

# The Critical Frequency limits close contacts

- The critical frequency ( $f_c$ ) is the highest frequency that will be reflected from the f-layer going straight up (90 degrees)



Example:  
MUF @ 30 deg. elev.  
 $5/\sin(30) =$   
10MHz, so there  
will be no reflection  
above 30 deg. at  
10MHz  
Also no reflection  
Above 20 deg on  
14MHz

The maximum usable frequency (MUF) =  $f_c/\cos(\text{incidence angle}) = f_c/\sin(\text{elevation angle})$

# Using Critical Frequency

- Let's say I want to talk to my friend Joe in Sacramento which is about 500 miles away at 7PM local, 0300 UTC
  - Looking at the skip chart we see that the elevation angle for an f2 hop is 50 degrees
  - Looking at the critical frequency chart it is around 4MHz and headed down
  - $MUF = 4 / \sin(50) = 5.2\text{MHz}$ , so 60M is the highest frequency I can use for that path
  - One hour later the MUF drops to 3.9MHz and holds steady, so 80M would be a good choice if you want to chat for a while.
- Another way of using it is to see what will happen at a specific time. I get on at 1300 UTC most days and 80M is the only band where I have a chance for local contacts. The fc is sloping up at that time so I will start hearing stations from the mid-west and closer stations on 40M by 1400
- Operation planning can be done using the critical frequency and skip charts together
- The critical frequency changes with season and solar conditions



# Making an Antenna Choice

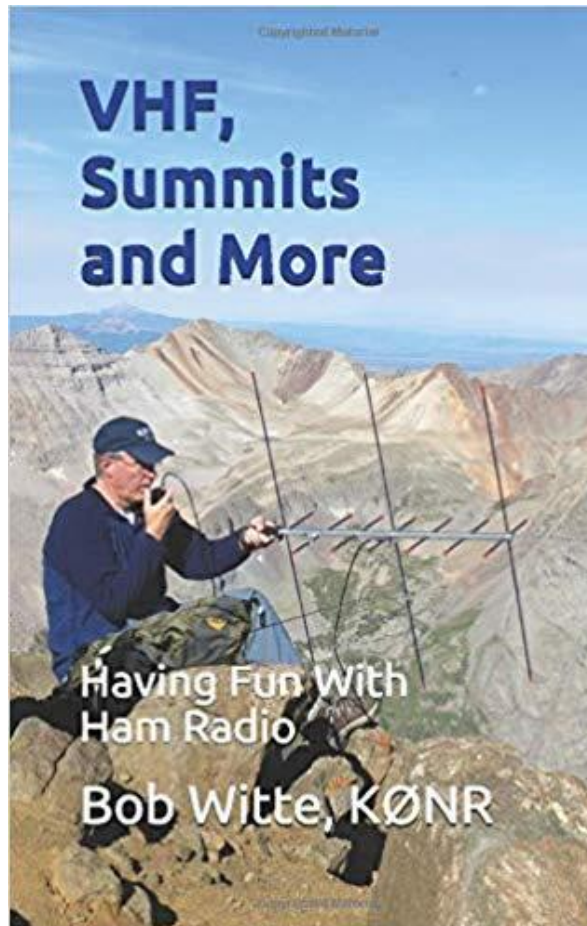
- At this point in the solar cycle the best bands are:
  - 40M for DX at night
  - 40M for local contacts during the day
  - 20M during the day, mostly DX
- Looking at the antenna summary:
  - 40M and 20M DX both favor a vertical
  - 40M daytime favors a dipole or EFHW
  - A 40M EFHW also works on 20M
  - EFHW in an Inv-L configuration has both low and high angle radiation
- Thinking ahead, 17/15/10M will open in a few years
  - At the start of cycle 25 these will be daytime DX bands favoring a vertical
- My fixed portable antennas are:
  - EFHW for 40/20M or a 20M Inv-V using a 25-30' fiberglass telescoping mast, requires no tuner
  - Multi-band vertical like a BuddiStick, MP-1 or Wolf River Coil, best with modest tuner (3:1 VSWR tuner)
  - If I have the fiberglass mast with me, I can use a 25' vertical wire and one or two 25' elevated radials on 40-10M with a wide range ATU

# Antenna Comparisons

- An antenna is a small system, not just the radiating element.
- Most analysis assumes ideal conditions which are seldom achieved
- An antenna system consists of:
  - The radiating elements including counterpoise wires
  - Feedlines can add loss and radiate common mode currents
  - Ground and terrain can add loss and affect low angle performance
  - Surrounding structures absorb and reflect signals
- Comparisons like the ones I present should be used as guidelines. Once you decide on your design you can do a more accurate model.

# VHF/UHF Portable

- I recommend reading Bob Witte's excellent book *VHF Summits and More* to get started on VHF/UHF



# Appendix

- Short vertical analysis
- Mobile

# Short Vertical Analysis

Using EZNEC 6+ at 14.050 MHz with the base up 5' and two  $\lambda/4$  radials:

<u>Vertical Length</u>	<u>Gain</u> (dBi)	<u>Peak Elev.</u>	<u>Impedance</u> ( $\Omega$ )	<u>Load</u> ( $\Omega$ )	<u>Q</u>
17' (ref)	-0.2	23°	54-j60	n/a	
8'	-0.1	26°	5-j537	n/a	
5'	0.2	27°	2-j906	n/a	

## Adding Center Loading

8'	-1.3	26°	13	950	300
5'	-4.1	27°	7	1600	300

## Loading 30% from the feed point (like a Buddi Stick)

8'	-1.1	26°	11	750	300
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## Base Loading (Small diameter coils like the AX1 probably have a Q=100)

5'	-7.7	27°	11	906	100
5'	-4.2	27°	4.8	906	300

# Short Vertical Summary

- A  $1/8\lambda$  center loaded vertical like a Buddi Stick is quite efficient, only 1dB gain reduction
- Base loaded 5' verticals are about 1 S-Unit worse. When conditions are good this is not bad
- The key to the best vertical performance is to elevate the base and radials. A short coax run is also helpful
- Elevated radials should be kept above ground as much as possible. The slope to ground raises the feed point impedance.
- An antenna tuner is often needed. The 3:1 ATU in many radios should be fine.
- BuddiStick, Super Antenna MP-1 or Wolf River Coil antenna are all good choices for portable operations

# What will I use?

- POTA Solar minimum
  - 100W radio @ 50 watts, 30aH LiFePO battery
  - Dipole or vertical depending on band and time
- POTA Good conditions (in 2-3 years)
  - 10-20W , 12aH battery
  - Dipole or vertical depending on band and time
- POTA at solar max (in 5 years)
  - 5-10W
  - Dipole or vertical depending on band and time
- Pedestrian Mobile in good conditions
  - 10W
  - Vertical with trailer or Alex loop

# Mobile Considerations

- Modern cars are not mobile friendly
  - Getting DC power to the radio may be challenging
    - You may need to drill a hole into the engine compartment
    - Accessory outlets can not supply enough current
    - You must fuse both the positive and negative wires
  - Body panels often use non-metal parts and grounding is not consistent. This can affect antenna performance.
  - Many auto manufacturers have RF power level specs to avoid affecting the car's many computers. These are often difficult to find.
- Finding a chassis ground antenna mounting location may be a challenge
  - Trunk lip mounts work well
  - Mag mounts work also
- Where will you mount your radio?
  - Removable front panels are popular
  - Cup holder mounts

