“This is KS1G *Bicycle* mobile”

Steve Greene

KS1G

ks1g@arrl.net

Presented @ Loudoun Amateur Radio Group (LARG)
April 21, 2012
www.k4lrg.org

What is “Bike Mobile Radio”?

Not this (Ellen would never agree!)….

More like this….

Me!

Not that Steve*!… (I have my pride)

(*Steve Roberts, N4RVE)

Why?

- Combine two favorite activities – cycling and ham radio.
  - Casual operation, drive time/commute
  - Public Service/event support
  - Contests (VA QSO Party)
- Solve the technical & operating challenges
- Fun!

Getting Started

What do you want to do?

- VHF, HF, DC-Daylight?
- Portable/Rover? In-Motion?
- How much to make bike into a radio station? How many permanent (not quickly removed) changes to the bike?
  - Minimal – road bike for special events
  - Regular – drive-time commuter
  - All-up – HF for VA QSO Party

SAFETY FIRST!

- RIDE FIRST. LISTEN SECOND. YAK THIRD.
- No compromises to safe operation of the bike
  - Stuff comes loose! Wires fall into wheels & drivetrain.
  - Radios & extra weight change how bike handles.
  - Wires connect you to the radio and the bike
  - Antennas can strike other objects, people, OVERHEAD WIRES!
  - RF Safety – for operator and bystanders
  - Battery safety – Fusing, charging, spills

Bike-Specific Stuff

- A bike is a severe, outdoor, high-vibration environment for electronics
  - Murphy says:

    “<u>Anything</u> that can shake loose or fall off will!”
  - Rough on radios, connectors, antennas, mounting hardware
  - Equipment is exposed to weather, sun, theft
  - Limited space, weight, poor RF ground

VHF/UHF

- Easiest way to start
  - VHF or multiband hand-held radio
    - Self-contained, many are weather-resistant
    - Mount on handlebars, place in a bag, carry on clothing
      - Best IMO is a RAM-MOUNT system on the handlebars.
  - Headset (noise cancelling) with PTT
    - ESSENTIAL for in-motion use
      - Speaker mikes require one hand and are too easily dropped into wheels!
      - Noise cancellation and wind screen improves readablilty
    - Mount PTT switch on handlebars near brake & shift levers.
      - VOX may not work – breathing, traffic noise, yelling will set it off
    - Cover 1-ear ONLY (safety and it's the law)
  - Antennas
    - ¼ wave (with ground/counterpoise), ½ wave "no ground" whip, J-poles
    - Ground-independent antennas work the best
    - Use strain relief - direct-mount SMA whips break connectors!
  - Amplifier
    - 5W plenty near repeaters, 20-35W amplifier in fringe areas & simplex

HF

- More of a challenge – everything is bigger!
  - Radios not intended for exposed mounting on handlebars
  - Mobile antennas are inefficient
  - Power. More = Bigger Battery = Heavy!
  - It can be done
    - QRP is easier, HFPack amp for 25-35W
    - Compact rigs with remote front panel (FT-857)
    - In-motion very feasible on higher bands
    - SSB typical. Many folks use CW! Digital still rare.
    - Contests, rare counties, special events good for >+3dB!

HF Antennas

- Requirements: Lightweight, rugged, does not harm bike handling; safety of rider, other people, property
- Mobile:
  - Small mobile antennas are inefficient on cars, bike is worse
  - Limited antenna size, placement, poor RF ground
  - Popular – loaded mobile verticals – Hamsticks, MP-1, Buddistick
  - Simple & works - 102” whip + manual or auto tuner (Elecraft T1)
- Portable:
  - Larger verticals with counterpoise/radials
  - Loaded dipoles (Buddipole)
  - End and center-fed wires, use trees or lightweight masts/poles
  - Anything you’re willing to carry on bike

My Bike-Mobile Station(s)

- Public service events (Reston Century)
  - VHF simplex, UHF (near RTC)
  - APRS “useful/nice to have”
  - Operate self-contained for 8-10 hrs
  - Be able to monitor the net while in motion
- Commuting
  - VHF/UHF repeaters, all-weather, easy to switch bikes
  - Like the century ride support, shorter operating time
  - Yak while in motion desirable
- Virginia QSO Party
  - Multi-band HF + VHF, stationary mobile or rover-style

Commute, Century Rides

- Radio - VX8 HT, spare battery, Bluetooth headset, speaker mike (GPS and backup the headset).
  - Previously - VX5 HT, headset, Byonics APRS tracker.
  - Add small amplifier for better coverage
    - Heavier, bigger, more complicated
- Antenna - Larsen 2M ½-wave (no ground plane required), homebrew ¼ wave, long HT whip, bike flagpole J-pole
  - Larsen has the best demonstrated performance, size, mounting location, weight
  - Attached to a behind-seat water bottle mount
    - Inspired by Great Ohio Bike Adventure (GOBA) comms
  - ¼ wave whip is simple & cheap, but lacks range

2010 Reston Century “Bike 1”

Larsen End-fed ½-wave “no ground” antenna (NMO mount on right side bottle holder)

VX8 on RAM-Mount. Speaker mike for GPS, backup (not in motion!) when BT headset battery runs out

Byonics APRS tracker & ¼-wave whip on bottle holder (under plastic rain bag)

Murphy Strikes!
(Duct tape to the rescue!)

Duct tape field repair after a critical attachment holding the APRS tracker to the bike failed 10 miles earlier when a lock washer didn't (do it's job)!
I now use lock nuts that don't fall off at mile 20 of a 100 mile ride!

Evolution: 2003 – 2012

2003

2004

2005

2008

2009

2006

2007

2010

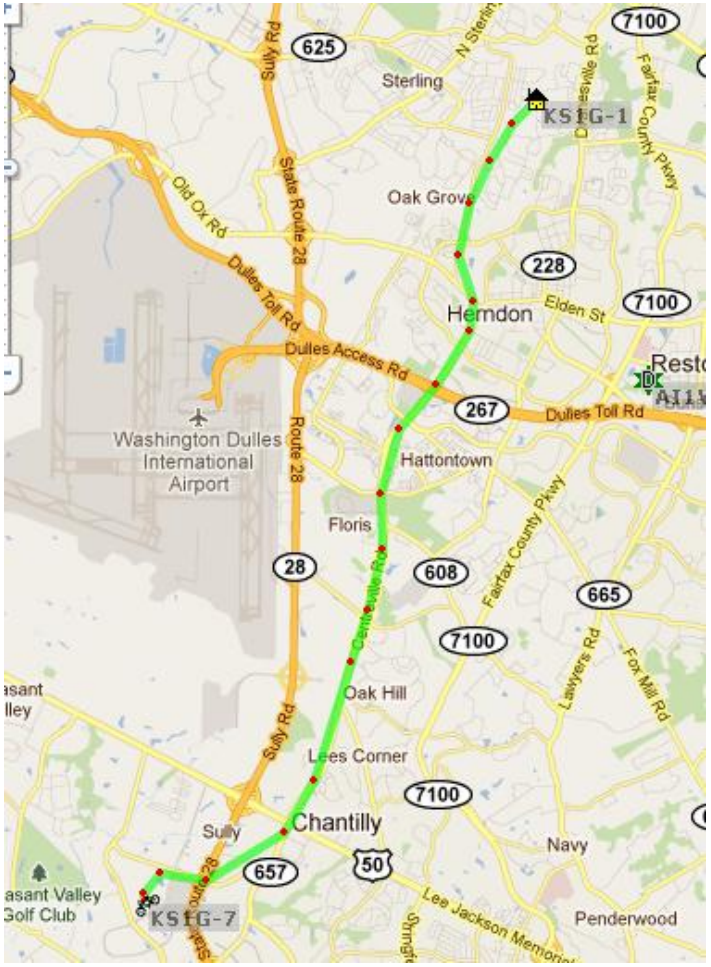
2012 (VA QSOP)

?? 2011

Century Communications Support - Bike Mobile Voice & APRS

	2010	2011
Radio & Handlebar Mount	Yaesu VX8 @ ~4W RAM-HOL-BC1U on RAP-274-1U (EZ-ON/OFF) or RAP-SB-187U (EZ Strap)	Yaesu VX8 w. GPS RAM-HOL-BC1U on RAP-274-1U (EZ-ON/OFF) or RAP-SB-187U (EZ Strap)
Headset	Plantronics Voyager Pro, speaker mike	Voyager Pro, portable "Mintyboost" recharger
Antenna	Larsen HW-1 "no ground" on seat-back bottle holder	Larsen HW-1 "no ground" on seat-back bottle holder
Amplifier	None	Mirage B23G @ 18-30W (depends on VX8 power level)
External Battery	None, carry spare VX8 pack	6.6 AH LiFePO4 in water bottle (batteryspace.com)
APRS	Tracker: Byonics MicroTrak, 8xAA batteries, 1/4w whip on seat-back bottle holder	VX8 built-in APRS
Weight	+ ??? Byonics Tracker	+ 30oz battery, 32 oz ??? amp
Coverage	Many gaps & drop-outs	Pretty solid

More dB = HUGE Difference!



(Using APRS data @ findu.com to compare changes in coverage)

- Add amplifier
  - Daiwa LA-2035R
  - 7AH SLA battery (Heavy! 5-6#)
  - VX-8 @1W -> ~18W out @ estimated 2.5A
  - +6.5dB vs. “barefoot” HT (~4W)
- Vastly improved APRS coverage (even with no packets while talking)
- Improved voice coverage, too
  - WA4TXE/R: Minimal dropouts, better audio - reduced mike gain stops noise processor clipping
- But - SLA Battery impractical
  - Too big/heavy on road bike
  - I want a lighter battery for commute, too!

So where do you put an amp and a **BIG HEAVY** battery on a road bike?

- **You DON'T** – Get battery with better size & weight specs
  - NO RACK, space for a jumbo seat bag taken by bottle holders
  - Battery – 6.6AH LiFePO4 in a bike bottle (batteryspace.com)
- Amp mount – simple & (I think) creative:
  - Small handlebar bag plus a bracket to stabilize bag
  - Provides some weather protection and vibration isolation. Amp ventilation may be a problem (talk less!)
- Estimated weight penalty: 1# for battery, 1# for amp, 1# for rest.
  - Measured: battery @ 1# 14oz, vs. full water bottle @ 1# 10oz

Daily Battery Requirements

- Daily Commute – Assumptions:
  - VX8 @ 1W -> 18W from amplifier, 2.5A @ 12V
  - 2 Hr operating time/day (commute x 2)
  - 25% transmit cycle (0.5 hrs) for voice
  - APRS –1 beacon/2 minutes (assume 2 sec/beacon)
  - 50% margin (extra talking, cold/hot temps, NiMH discharge curve)

2 Hr x 25% x 2.5A = 1.25 AH
+ 2 Hr x (60/2) x (2/60/60) = 0.03 AH
+50 % = 0.64 AH
TOTAL = 1.92 AH

  - 2AH battery is MUCH lighter – 2 pounds vs. 5.5 (SLA)!
    - Or ~6AH NiMH, larger LiFePO4 @ 2-3 pounds, “A123” LiFePO4 < 1 pound.

Maximum Battery Requirements

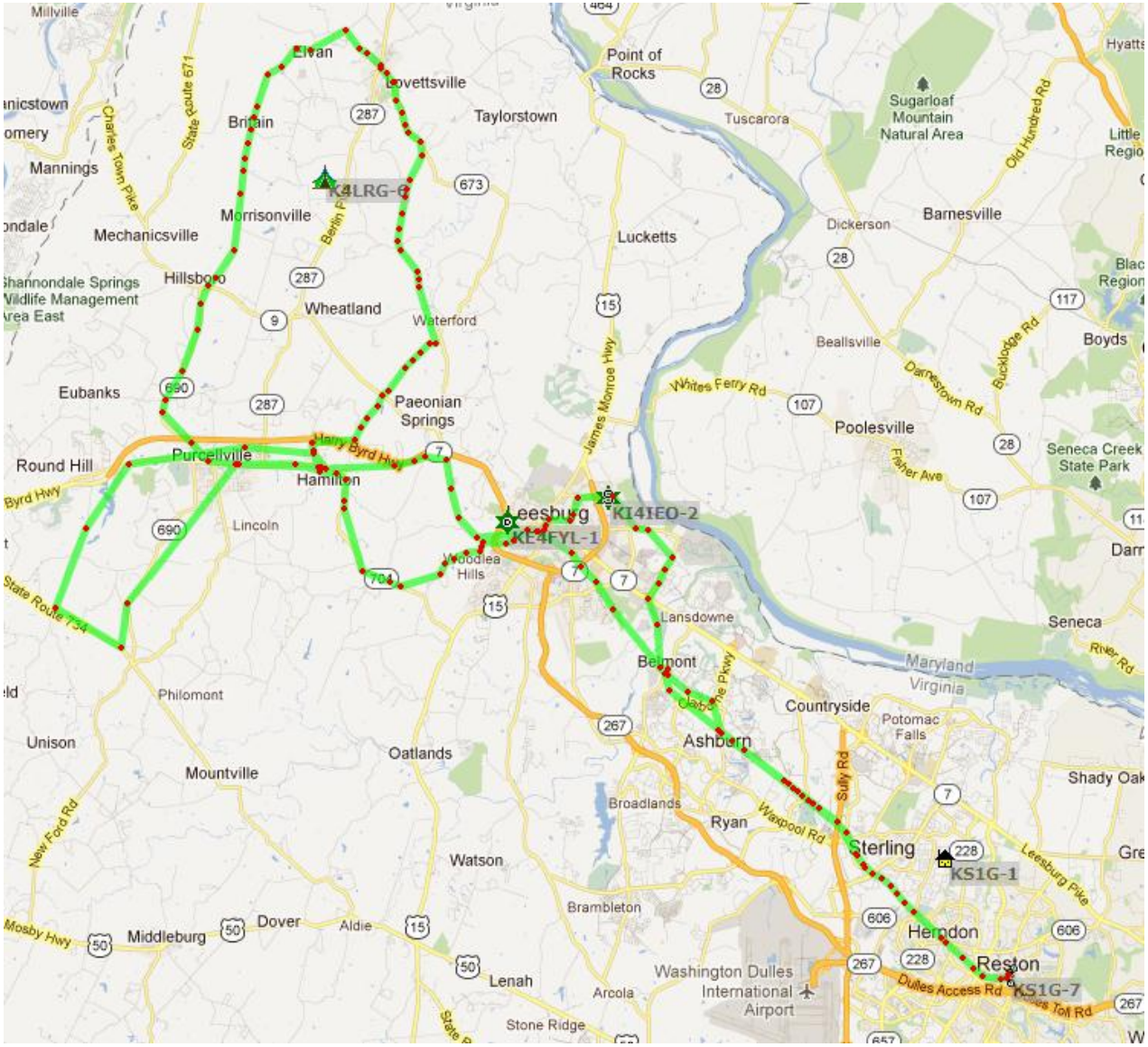
- Century Communications Support - Assumptions
  - VX8 @ 1W -> 18W from amplifier, 2.5A @ 12V
  - 8 Hr total, need 6 Hr operating time (no amp for 1st and last hour)
  - 10% transmit cycle (1.2 hrs) for voice
  - HT draws 0.24A from battery for receive, 1.7A @ 5W, 0.5A @ 1W
  - APRS – 1 beacon/2 minutes (assume 2 sec/beacon)
  - 25% margin (extra talking, discharge curve)

8 Hr x 0.1 x 2.5A = 2.00 AH
+ 8 Hr x (60/2) x (2/60/60) = 0.13 AH
+ 8 Hr x 0.24 + 0.1x(2 Hr x 1.7 + 6 Hr x 0.5) = 2.56 AH
+25 % = 1.17 AH
TOTAL = 5.86 AH

  - 6.6 AH LiFePO4 @ 1.7 pounds (Batteryspace.com bike bottle package)
    - Save power - use HT internal battery, turn off amp when not needed
  - Future – solar charging during day is feasible (although I don't need it)

It Works!

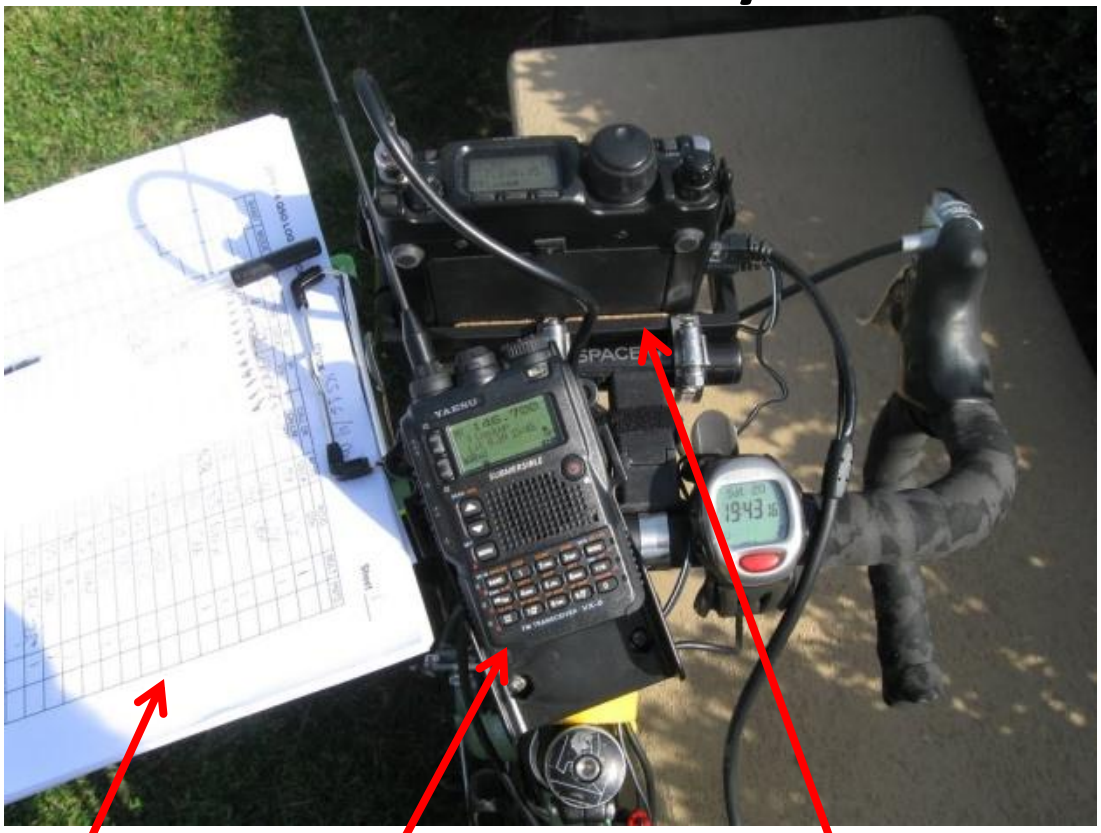
2011 Reston Century KS1G-7 “Bike1” Track



HF Mobile –VA QSO Party

- FT-817 (bracket clamped to handlebars), external SLA or spare battery, Heil Traveler headset
  - Mounting bracket no longer made, equivalent can be built
- MP-1 manual-adjust screwdriver antenna
  - In-motion: 12” base rod, 3’-4’ flexible top whip
  - Stationary: MFJ 12’ telescoping rod replaces flexible whip
- Adjust MP-1 tuning after QSY, Elecraft T-1 tuner
- Batteries, gear in rack trunk
- HFPacker amplifier
  - Less operating time/bigger battery, no QRP multiplier

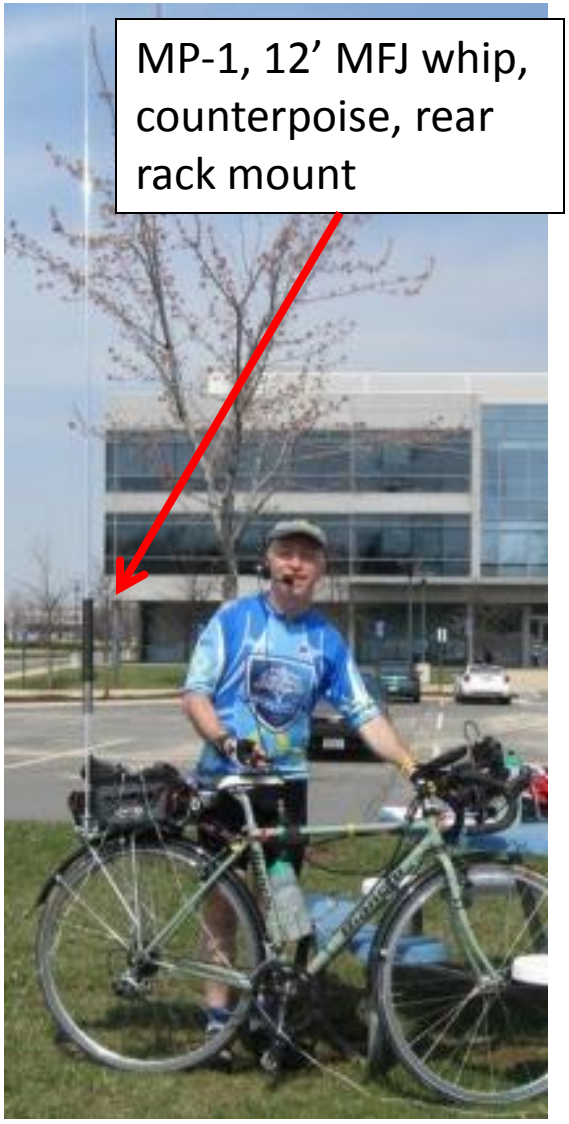
VA QSO Party HF Station (2010)



Log sheet clipboard

VX8 on RAM-Mount

FT-817, Mountain Ops mobile bracket & handlebar gadget mount



MP-1, 12’ MFJ whip, counterpoise, rear rack mount

Evolution – 2012 VA QSO Party

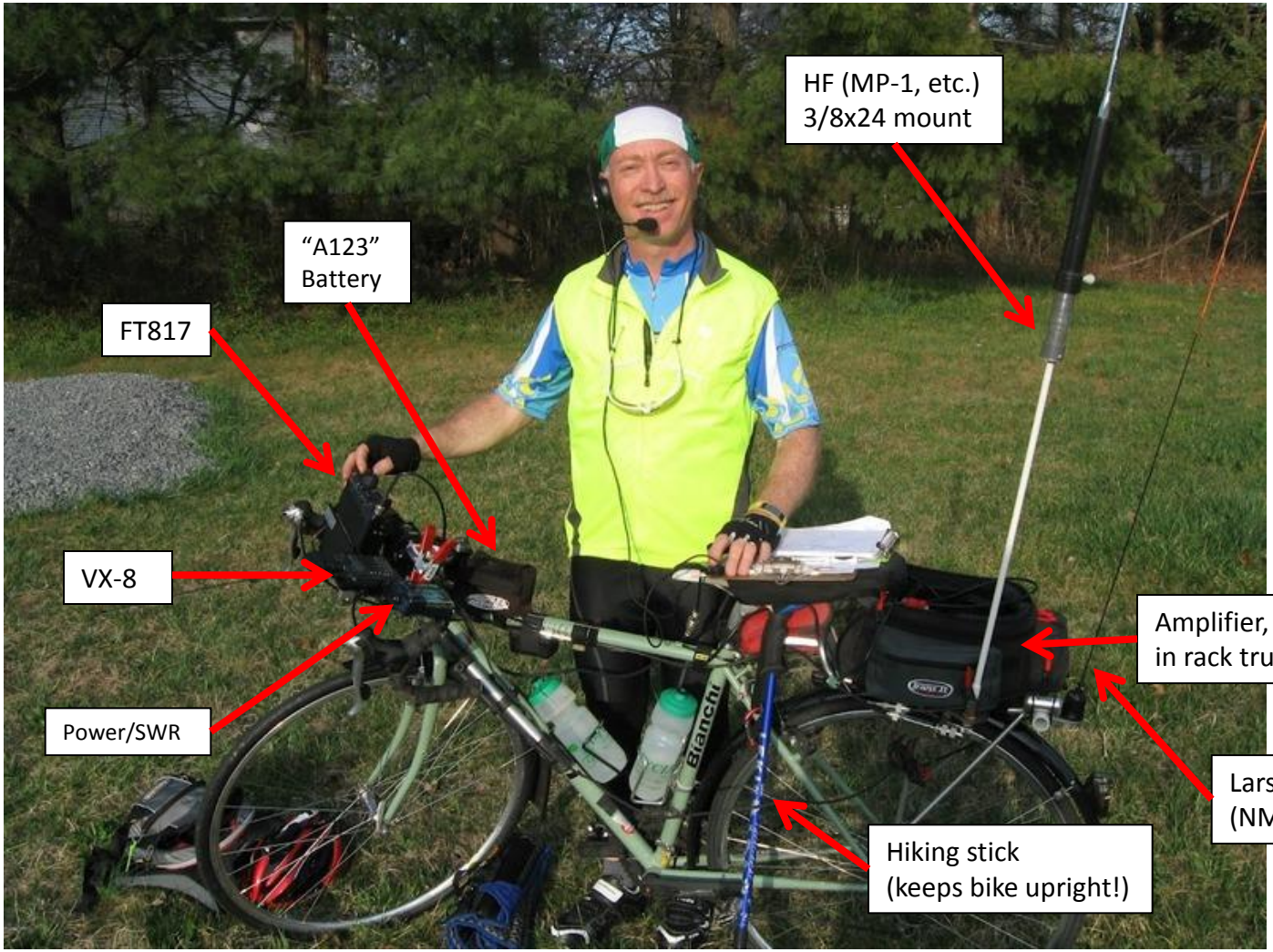
Same:

- Radios, Antennas
  - FT-817, VX8, handlebar mounts.
  - HF - 22” Hustler base rod, MP-1 coil, MFJ 12’ whip
  - VHF - Larsen HW-1
  - NMO, 3/8x24 antenna mounts bolted to rear rack

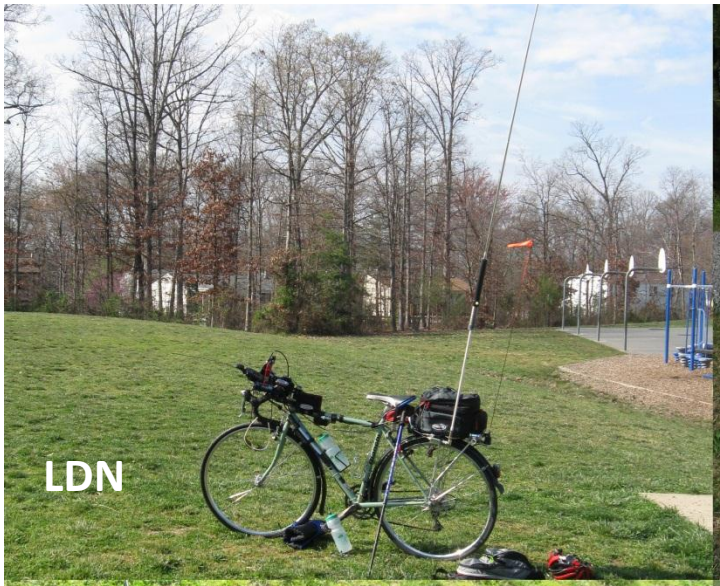
Changes:

- HFPacker 25-35W amplifier
- LiFePO4 batteries for amplifier & radio
- Activate more counties/cities
  - W&OD, Four Mile Run connect ALX, ARL, FCX, FFX, LDN

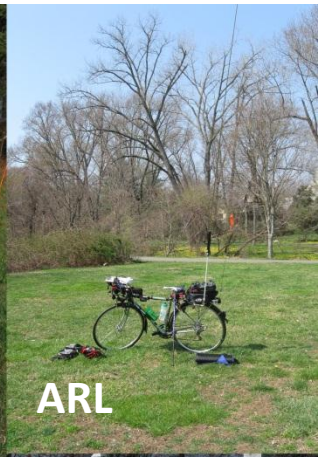
KS1G/M 2012 VA QSO Party



2012 VA QSO Party


LDN

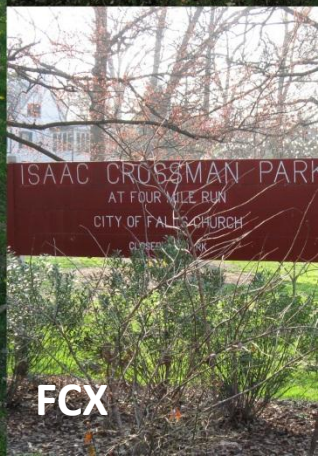

FFX


ARL

ALX


KS1G/M "Shack"

ARL/FCX



FCX

Results – 2012 VA QSO Party

- Approx. 14 hours total operating time
  - Not including transit time between locations
- 122 QSOs
- Activated 5 counties/cities: ALX, ARL, FCX, FFX, LDN
- Plenty of battery power, good signal reports on 40M and 20M
- Murphy paid a visit – TWO flat tires (don't forget the non-radio bits of the station!)

Trailer = Bigger Station

NF0N Field Day 2009 - http://groups.yahoo.com/group/BMHA/photos/album/471124015/pic/list
Burley Nomad Trailer, Buddistick, FT-817

Hints & Kinks

- Cycling is hard on mechanical connections and connectors
  - Loctite and lock nuts are your friends. Lock washers are false friends.
  - Provide strain relief for power & RF cables
  - Subminiature coax breaks more easily than RG58
  - I am now a big fan of crimp connectors, heat shrink tubing, and Velcro strips!
- Stuff will break miles from anywhere
  - Carry tools to fix bike, cut, safely stow broken mounts, cables, antennas, ...
- The bottom end gets wet, too
  - Protect anything that's exposed from rain & road spray
- Cycling, like talking, is an aerobic activity
  - Breath_for_Biking + Breath_for_Talking <= Breath_Capacity
  - I don't doing think both at once is a recommended training method!
- Bike flags are good antenna support but move around A LOT!
  - Be aware of what/who is above and alongside
- A telescoping hiking stick makes a very effective bike-stand
- Biking with a 2-way radio is unusual
  - Have a simple answer for "what's that?"

Future of Bicycle Mobile Radio

- More capable compact portable radios
  - VX8, TD72A combine voice & APRS in one unit
  - 100W HF+ with remote-able faceplate (FT857, etc.)
  - Digital modes (built-into radio, smartphone)
  - Small multi-mode QRP rigs - Elecraft KX3
- Bluetooth – no wires connecting you to the bike!
- Lighter, higher capacity batteries – LiFePO4, etc.
- Small amplifiers (HFPacker, Elecraft, etc.)
- ***Physics of antennas & batteries remain limiters!***

I WANT ONE! – Elecraft KX3

- **160-6 meters, SSB/CW/DATA/AM/FM modes**
- **10 W PEP (100 W with KXPA100 amp)**
- **Only 1.5 pounds (0.7 kg)**
- **Current drain as low as 150 mA**

- **Internal wide-range antenna tuner (ATU) and battery options; built-in speaker**
- **Advanced DSP**
- **Software-defined radio (SDR) architecture *plus* roofing filters (KXFL3) for excellent dynamic range**
- **Operate data modes (PSK31/RTTY) without a PC**

More Information

- **BMHA** – Bicycle Mobile Hams of America
  - Website http://bmha-hams.org/,
  - Yahoo group http://groups.yahoo.com/group/BMHA/
- **Hfpack** – Pedestrian-portable/mobile HF
  - Website http://www.hfpack.com/,
  - Yahoo group http://groups.yahoo.com/group/hfpack
- Other **Yahoo & Google groups**, **QRZ.com**, **Ehams**, etc.
  - Rig and equipment-specific lists and forums: **Buddipole**, **FT817**, **FT857**, **Elecraft**, **QRP-L**,….
- **RAM-Mounts** http://www.ram-mount.com/
  - Equipment mounts for almost anything
  - Mounts handheld radio on handlebars
    - RAM-HOL-BC1U – Belt Clip Holder
    - RAP-274-1U (EZ-ON/OFF), RAP-SB-187U (EZ Strap), motorcycle mounts

Ride Safe! & 73, de KS1G/4

"This is KS1G Bicycle mobile"