



Developed for Snohomish County ACS

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Send any comments/corrections to the Snohomish County Radio Officer

This is an x-ray view of an Icom ID-51A

# HT Applications

An "HT" makes perfectly good sense for:

- ◆ Anyone who doesn't drive
- ◆ Commuters who use public transportation
- ◆ Controlling a mobile radio as a cross-band repeater
- ◆ As a spare, a backup or loaner
- ◆ Ultra-portable field unit

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HTs have some limitations but are the perfect tool for many applications

## HT Issues

- ◆ Severely compromised antenna systems
- ◆ Limited battery life
- ◆ Limited power
  - ◆ Increasing power to overcome poor antenna systems reduces battery life
- ◆ Poor transmit and receive audio
- ◆ Accessories create cabling mess
- ◆ Small display size

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Not every HT has all these limitations but they often exist in the small packages

## Pick the right radio

- ◆ For emergency use, it needs to be easy to use
  - ◆ During an event is no time to get out the manual
- ◆ Features are cool but master the basics
  - ◆ Change frequency, duplex shift, tone encode, tone decode and program a memory channel
- ◆ Can you operate the buttons and read the display?
- ◆ Good battery life
- ◆ Can you turn off unwanted features (second receiver, scan, priority, weather alert, WIRES, etc.)?

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You may not even want or need features like second receiver, scan, priority, weather alert, Yaesu WIRES but they can be enabled accidentally. Know how to turn them off. Many of them can be a distraction and cause additional power consumption.

## Narrow-band FM

- ◆ FCC currently mandated switch to narrow-band
  - ◆ After January 1, 2011 -
    - ◆ No wide-band commercial radio can be certified
    - ◆ No more wide-band frequency allocations will be issued
  - ◆ This means commercial radios will not interoperate with amateur wide-band gear
  - ◆ Consider narrow-band capability in future radios
    - ◆ Should be easily selectable
    - ◆ Should be storable in memory

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This FCC narrow-band mandate only applies to commercial users (part 90). Amateur gear is generally 15-20kHz occupied bandwidth. Narrow-band means 12.5kHz occupied bandwidth. There will be a future move to Ultra Narrow Band - 6.25kHz. Shortly before and after the switch for land mobile users, many wide-band-only commercial radios and repeaters were dumped on the market. As amateur radio looks at moving toward narrow band, this equipment may be limiting and not a good buy. Similarly, modern commercial gear often does not support wide-band for amateur use. Proper support for narrow band should be a consideration to avoid obsolescence.

## Portable APRS

- ◆ Kenwood TH-D72/D74 includes TNC with APRS
  - ◆ Internal GPS
  - ◆ USB jack for PC connection
- ◆ Yaesu VX-8R includes TNC and APRS software
  - ◆ Older Yaesu GPS mounts on radio or speaker/mike
  - ◆ Bluetooth headset support
  - ◆ No PC interface

Since the Yaesu radios don't have a PC interface, they are a fancy APRS "tracker". The Kenwoods allow full access to the TNC via USB (and Bluetooth in the TH-D74) for use with APRS and Winlink software.

## Early Digital Voice Modes

- ◆ D-STAR
  - ◆ Full line of DSTAR HTs and mobiles
  - ◆ All offer backward compatibility to FM
  - ◆ All offer data jack for PC connection
  - ◆ Supports routable voice calls via Internet
- ◆ APCO Project 25 (P25)
  - ◆ Radios available from most manufacturers
  - ◆ Very robust voice
  - ◆ Virtually no data support and cannot route voice

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P25 radios are largely used by public safety users but are too expensive for most users. DMR has emerged as the less expensive alternative.

## Newer Digital Modes

- ◆ DMR
  - ◆ Radios available from several manufacturers
  - ◆ Two time slot TDMA trunking
  - ◆ Multiple talk groups available via Internet linking
- ◆ Yaesu System Fusion
  - ◆ Yaesu has portables, mobile and base models
  - ◆ Repeaters and radios support dual mode FM/SF
  - ◆ Offers high quality voice or 9600 baud data or combo

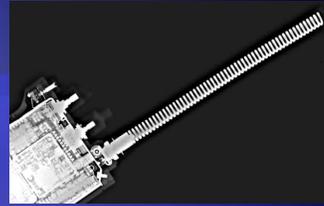
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DMR was developed as a commercial system and adapted for amateur use. Inexpensive Chinese radios from multiple vendors has made it very accessible for amateur operators.

Yaesu System Fusion is currently unique to Yaesu. Although it's a digital mode, there is no connectivity for data to a PC.

## “Rubber ducks”



- ◆ Some rubber ducks are as much as -20dBd
  - ◆ That's 100 fold or only 50mW ERP with 5W in
  - ◆ Most are -8dBd to -10dBd – still nearly a 10 fold loss
- ◆ Adding a counterpoise is a simple improvement
  - ◆ A piece of stranded wire (19.5" @ 2m and 6.5" @ 70cm) crimped/soldered to a ring lug slid over the antenna mount. A little heat shrink adds strain relief
  - ◆ Creates vertical dipole
  - ◆ Counterpoise can be pointed to provide directionality

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Most OEM rubber duck antennas are little more than elaborate dummy loads. They are extremely lossy and most any larger after market antenna will offer better performance. The operator becomes the ground plane for these antennas and despite the size and “saltiness” of some operators, they make poor ground planes. A counterpoise or “tiger tail” is easily made and can significantly improve the performance.

## When gain isn't gain

- ♦ Gain is often advertised
- ♦ Gain is expressed in decibels (dB)
  - ♦ Gain must be referenced to something
    - ♦ dBi – Gain vs. isotropic resonator
    - ♦ dBd – Gain vs. reference dipole
  - ♦ dBi is often used because it's larger
  - ♦ dBi is a calculated – not real world figure
  - ♦ Each 3dB is a 2-fold increase, 10dB is a 10-fold increase



Comet SMA- 501  
0 dBi at  $\frac{1}{4}$  wave -  
Not!

2.15 dBi is 0 dBd. Since dBi cannot be measured, only calculated, it is often calculated in the best possible idealized way. Only a dBd value has any chance of representing the real world gain.

## HT Antennas

- ◆ Bigger is almost always better
- ◆ Aftermarket 19" whips are full  $\frac{1}{4}$  wave on 2m
- ◆ Telescoping  $\frac{1}{2}$  wave antennas are VERY effective
  - ◆  $\frac{1}{2}$  wave with no ground plane has similar performance to  $\frac{1}{4}$  wave with a ground plane
  - ◆  $\frac{1}{2}$  wave antennas are often used for marine
- ◆ Almost anything OUTSIDE a vehicle is better



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$\frac{1}{2}$  wave antennas are useful with limited or no ground plane (boats, motorcycles, antennas hoisted in trees, pinned to walls and windows)

## Portable Antennas

- ◆ Twin lead J-poles provide gain and can be hung or tacked to a wall or window (N9TAX)
- ◆ Magnetic mount antennas can be used with any metal surface large enough for ground plane
- ◆ Tram makes a base to provide a ground plane and mount for an NMO base antenna
- ◆ Telescoping 2m and dual-band whips are compact and very effective with ground plane

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N9TAX antennas can be found on eBay and <https://n9taxlabs.com/>

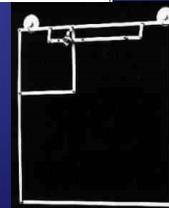
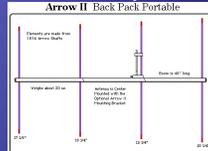
An improvised ground plane can almost always be found around the home or office, such as a metal filing cabinet, metal trash can, cookie sheet, rain gutter, refrigerator, window air conditioning unit, balcony railing or any other large metal object.

The Tram 1465, Larsen Base Station Adapter (BSA) Kit or Laird Mobile Base Converter (MBC) Kit all allow a standard NMO base whip to be used as a base station antenna with mast mount and integrated ground plane.

# Directional Antennas



- ◆ Tape measure yagi provides portability and gain
  - [http://home.att.net/~jleggio/projects/rdf/tape\\_bm.htm](http://home.att.net/~jleggio/projects/rdf/tape_bm.htm)
- ◆ Arrow Antennas
  - <http://www.arrowantennas.com/>
- ◆ Window Quad
  - [http://www.wimo.com/framesetp\\_e.html](http://www.wimo.com/framesetp_e.html)
  - Wimo offers other portable designs



# Battery Technologies

Type	Cell Voltage	Recharge Cycles	AA Capacity
Alkaline	1.5	None	2500 mAh
Nickel Cadmium (NiCd)	1.2	1500	900 mAh
Nickel Metal Hydride (NiMH)	1.2	800	1200 mAh
Lithium Ion (LiIon)	3.6	500	2700 mAh*

\* Adjusted for difference in voltage

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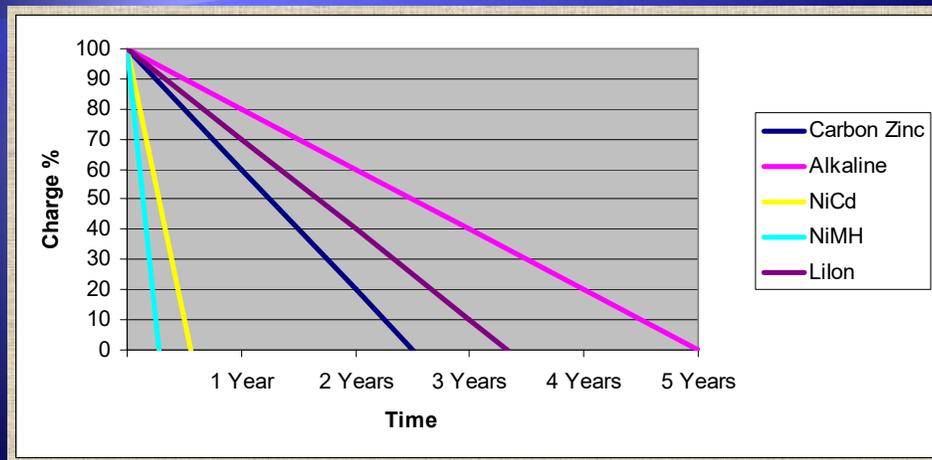
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The chemistry of the battery determines the cell voltage. These numbers are rounded a bit.

Recharge cycles refers to the number of times a battery can be charged back to at least 85% of its capacity. Again these numbers are approximate and represent similar regular maintenance. A number of factors can change these numbers; heat, discharge/charge rates, frequency of charge, depth of discharge, etc. Although NiCd batteries have a bad reputation for memory effect (and other rechargeable technologies to a lesser degree), this can be eliminated with proper handling and a modern charger.

The milliAmp hour capacities shown here are typical for a standard AA size battery using the various technologies. Newer/higher quality batteries can have higher capacities. The Lilon battery value is adjusted for the different voltage to more accurately be compared with the other batteries.

# Battery self-discharge rates



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All batteries will discharge while sitting on the shelf. Most alkaline batteries now have a date printed on them to show their shelf life. Since rechargeable types can simply be recharged, there's no date. All battery types will discharge faster at higher temperatures. Storing batteries in the refrigerator or even freezer can extend their shelf life substantially.

The older NiCd and NiMH technologies have very fast self-discharge rates. You can charge these batteries and place them on a shelf and within weeks, they'll be dead. They can not be relied on for emergency use. They are often still used in power tools because they have the ability to be discharged at the very high rates to run motorized tools. Shelf life is generally less important in these devices.

## Enough is never enough

- ◆ Most NiCd or NiMH packs are 800-1500mAh
- ◆ High transmit power quickly drains power
- ◆ A busy 8 hour shift could drain two packs
- ◆ Newer Lilon batteries run 1200-3500 mAh
- ◆ Keep an extra rechargeable pack and/or AA pack
- ◆ AA alkaline packs generally provide lower output
- ◆ Recharge regularly and store in cool/dry place

## More power!

- ◆ Small sealed lead acid (SLA)/gel cell batteries are easy to find in UPSes, medical equipment, etc.
- ◆ LiFePo batteries are very effective
- ◆ A small case or backpack with a battery, connectors and charging system could provide power for many days
- ◆ A pair of batteries would allow one to be used while the other is charged

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Newer lithium batteries have several advantages, primarily, weight and shelf life. The cost of a lithium appears significantly higher than a similarly-sized lead acid but that is not entirely accurate. Lead acid batteries can only usefully discharge to 50% of their rated value but LiFePo batteries can discharge to 80%. This means a 50Ah LiFePo battery and an 80Ah lead acid battery both can safely supply 40Ah. Comparing those prices is much closer.

# Anderson Powerpoles



- ◆ Powerpoles are polarized and genderless
- ◆ They are the ARES/RACES standard connector
- ◆ Run power to the battery in every car and leave the end available under the dash for quick hookup of any radio (don't forget fuses)
- ◆ Easily create adapters for any application



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# Powerpole adapters



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This combination of Powerpole accessories is very powerful. The small charger, battery, male/female cigarette lighter adapters and alligator clips allows powering most anything and charging from almost any 12v source.

## Verify battery integrity

- ◆ Batteries deteriorate over time
- ◆ Verify battery capacity with smart charger or tester
  - ◆ West Mountain Radio offers a Computerized Battery Analyzer (CBA)
  - ◆ Cadex C7400 available with “universal” cups
  - ◆ Operate the radio on receive and record the run time



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The West Mountain Radio CBA can apply a constant selectable load on a battery and record the discharge curve to a PC connected via USB. It allows identifying the actual capacity of a battery. The Cadex device can do this as well but at much higher cost. The cheapest solution is to just leave the radio on and monitor it until it dies. Many radios include a volt meter that can help record the discharge curve.

## Maximize battery life

- ◆ Use minimum necessary transmit power
  - ◆ An improved antenna system can help substantially
- ◆ Keep radio squelched
- ◆ Use minimum required volume setting
- ◆ Disable backlighting when not in use
- ◆ Enable any power saver feature
- ◆ Disable scanning and second VFOs

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It is possible to reduce the standby current on a radio with prudent use of features.

## Generate your power



- ◆ The Honda EU1000i is only 30lbs - with fuel!
  - ◆ It does generate some noise on HF SSB but for VHF and FM work, it's fine
- ◆ "Solar Generators" provide multiple types of power and are easily charged
- ◆ Solar panels are easy and silent



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Folding solar panels can provide reasonable current for charging radios and phones.

## Improve audio

- ◆ Speaker mikes place speaker closer to ear
- ◆ HT transmit audio notoriously “boxy”
- ◆ Headsets provide better audio in high noise environments
- ◆ Keep radio safely out of the weather or attached to power and antenna



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Many of the OEM and aftermarket headsets can be quite compact. Heil offers a line of larger headsets that have excellent audio quality.

## Program and go

- ◆ Get repeater and simplex frequencies
  - ◆ Check <http://www.WWARA.org> list
- ◆ Use alpha memories when possible
- ◆ Don't forget FRS/GMRS, weather, TV, aircraft, marine, itinerant (red dot, blue dot, etc.), public service, etc.
- ◆ Programming software makes this much simpler
- ◆ If the radio can transmit out of band, use odd splits to transmit in ham band when keyed

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WWARA has THE authoritative repeater list for Western Washington. It also has the complete band plan. You can download a full list of repeaters updated nightly in a human-readable PDF format, CSV and CHIRP format.

There are other frequencies that could be interesting that are easily found on scanner sites like <https://www.radioreference.com/>. Snohomish ACS has a substantial frequency template available on the WA7DEM.info web site at <http://www.wa7dem.info/online-docs>.

## More power!

- ◆ Mount a mobile in a box with a battery, small charger and portable antenna
- ◆ Pick a model with low standby current drain
- ◆ 15-25 watts can be used (50+w off car battery)
- ◆ Better audio from larger speaker and mike
  - ◆ Front firing speakers are helpful
- ◆ Generally easier to use (big buttons and display)
- ◆ HT with amplifier has limited duty cycle



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This is an Anytone AT-778UV with a Ryobi 18v tool battery. The Anytone is very compact with a 25 watt maximum output. There are simpler and more compact mounts for Milwaukee and DeWalt 20v batteries. There are details and more examples at <http://www.wa7dem.info/other-portables>.

# Design your portable station



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There are details and more examples at <http://www.wa7dem.info/other-portables>.

## Don't forget...

- ◆ Pens/pencils
- ◆ Paper
- ◆ Message forms
- ◆ Antenna adapters
- ◆ Extension cords
- ◆ Manuals
- ◆ Etc...



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Don't just focus on the radio. Consider an entire radio go bag and what should be included.

## References/Sources

- ◆ <http://www.cometantenna.com>
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