Foxhunting

The Art and Science of Radio Direction Finding

Background

- Theory
  - All radio sources are ripples in a pool of electromagnetism
  - Antennas and techniques can be used to locate source just like your ears locate sound

Uses

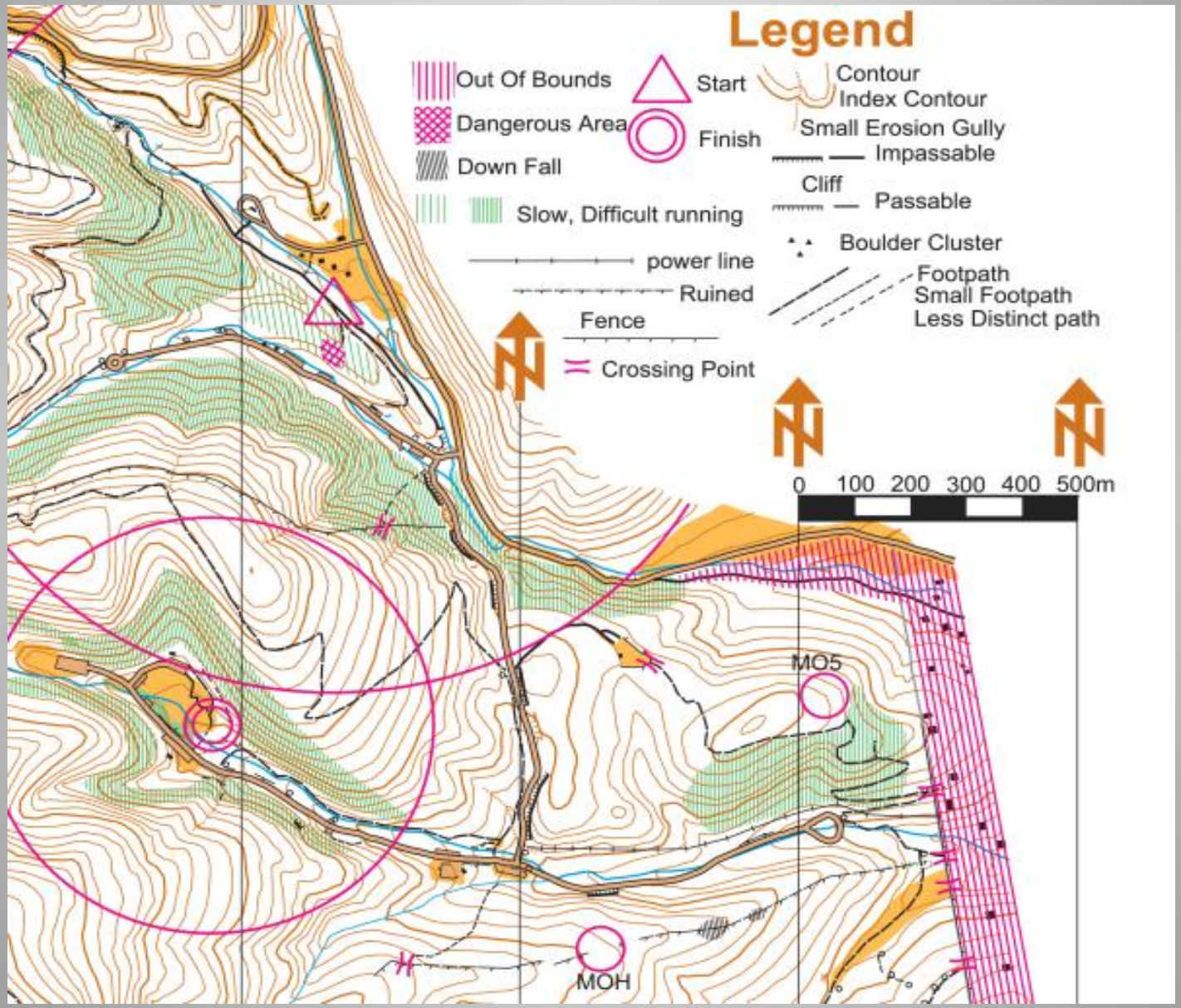
- Military
  - Locating jammers and enemy structures
    - Drug Cartels
- Civil
  - ELT/EPIRB Locating
- FCC/Amateur Radio
  - Locating harmful interference
  - Finding stuck transmitters
  - Foxhunting

Radio Orienteering

(Aka Radiosport)

- International sport of using ARDFing and Orienteering techniques to quickly locate multiple transmitters
- Distances vary, avg 6-10km
  - Fox Oring
    - 100m range transmitter
    - Searched over wide area
  - Radio Orienteering in a Compact Area (ROCA)
    - Park sized reception and search area
    - Focus on RDF rather than navigation

ARDF Map


Legend
Out Of Bounds
Dangerous Area
Down Fall
Slow, Difficult running
power line
Ruined
Fence
Crossing Point
Start
Finish
Contour
Index Contour
Small Erosion Gully
Impassable
Cliff
Passable
Boulder Cluster
Footpath
Small Footpath
Less Distinct path
0 100 200 300 400 500m
MO5
MOH

ARDFing Receivers

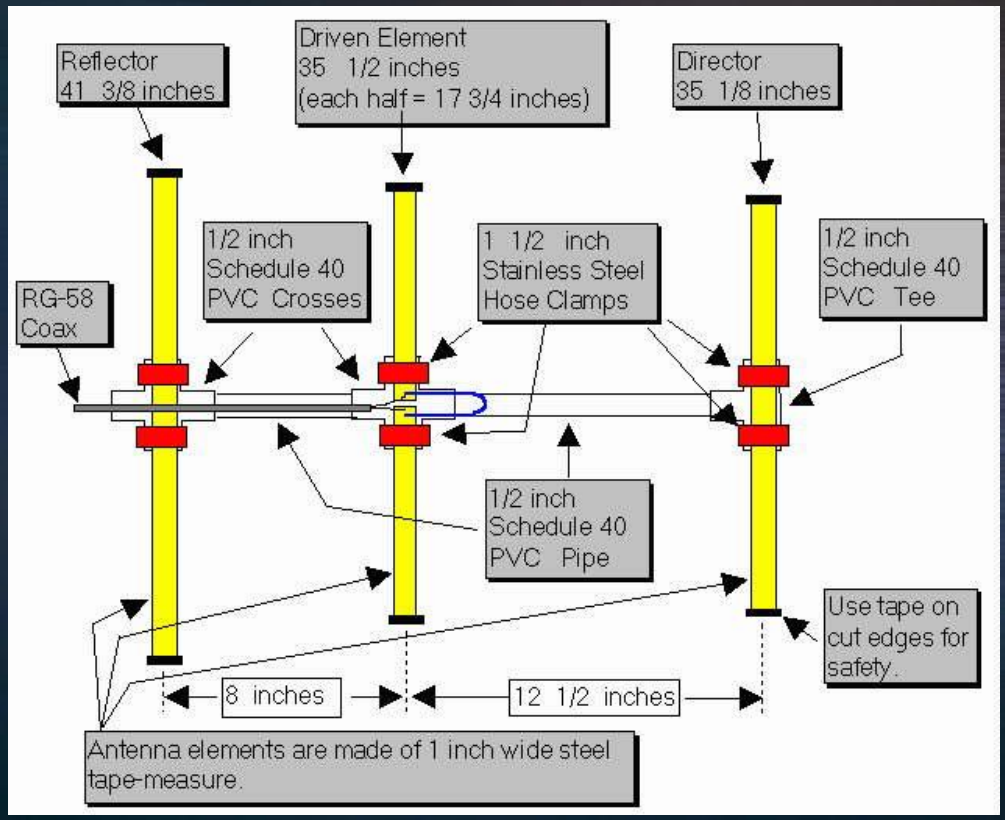
- Dual-band Handhelds are most versatile
  - Usually have a signal meter
    - Without makes it more difficult; use only noise
  - Ability to tune to harmonics of 2m band
  - Integrated attenuator is a plus
- Dedicated Doppler Units
  - Extremely fast and precise locating
  - Easy identification of multipath
  - Expensive

ARDFing Antennas

- Must be Directional
  - Single Antenna
    - Body Fade
      - Using the body to null one side
      - Inaccurate
  - Multiple Antennas
    - Yagi
    - Doppler
    - Adcock
    - Loop

Antennas Cont.

- The WB2HOL Tape-Measure Yagi
  - Easy to build (and cheap too)
  - Rugged
  - Uses cardioid pattern null rather than peak to determine bearing
  - Requires attenuation at close range



Antennas, Cont.

- Loops
  - Typically used on 80m
  - Bidirectional without modification (sense antenna)
- Adcock Array
  - Two Antenna Phased Array
    - Uses phase null to determine direction
    - Bidirectional like loops
    - Similar to how hearing works

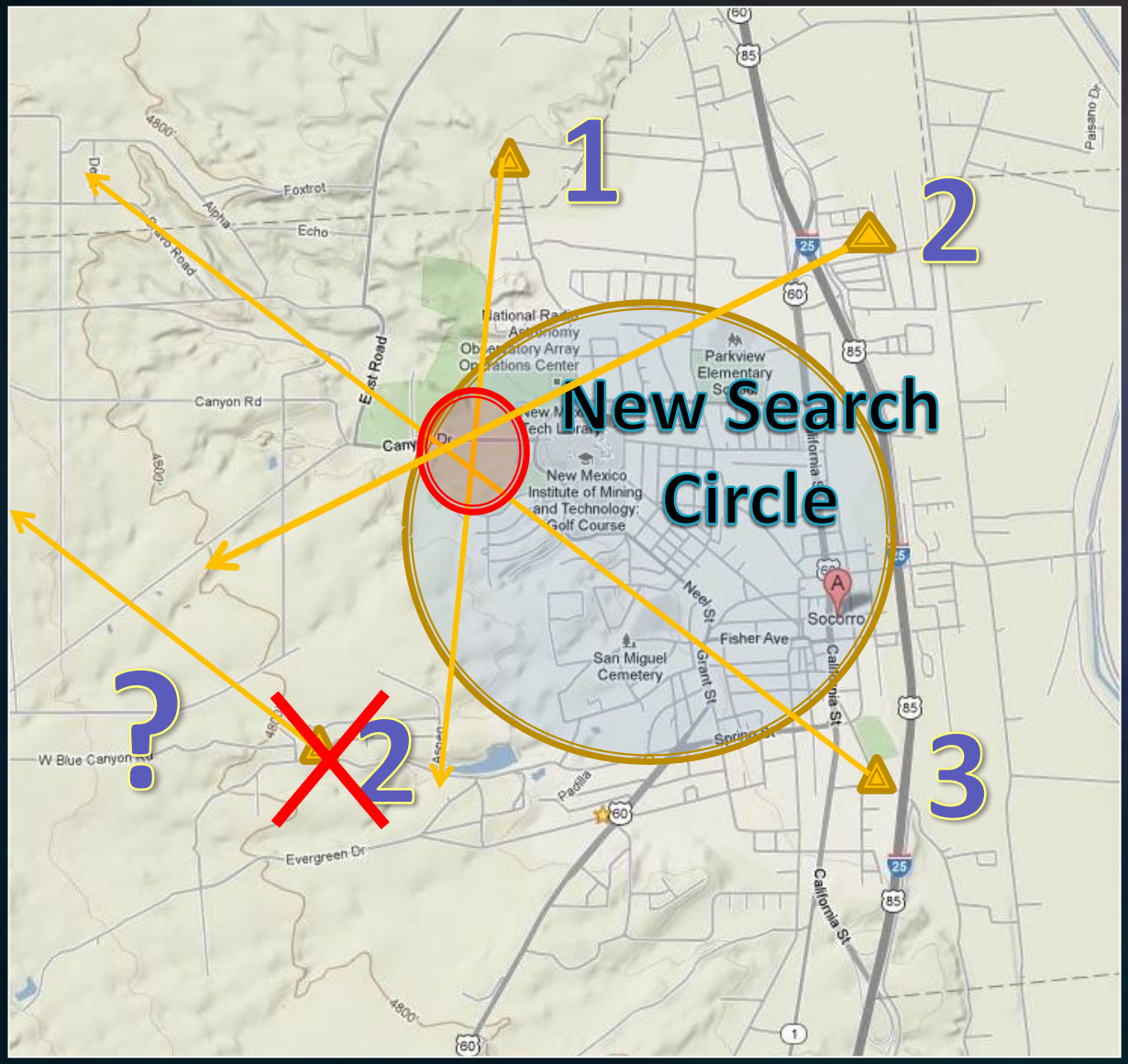
Antennas, Cont.

- Doppler Array
  - Requires at least 4, 1/4λ equidistant/equiplanar antennas
    - And a combining network
      - And a phase detector
        - And equal lengths transmission line
          - And time and money
- Correlative Interferometry
  - Think VLA

Locating Techniques

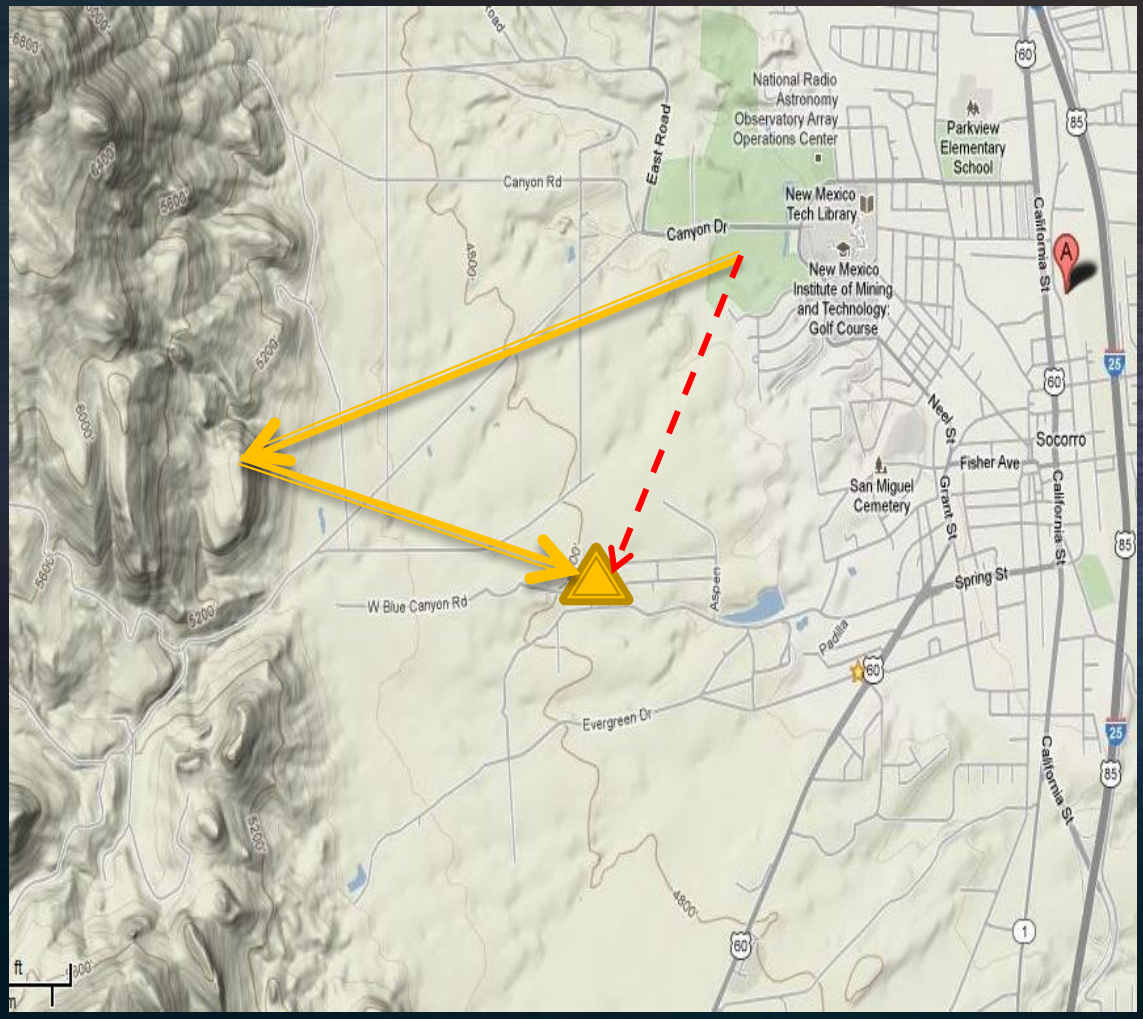
- Point and Run
  - Point to peak signal and go that way
  - Quickest
  - Prone to errors caused by multipath
  - Sensible on flat terrain or in close proximity
- Triangulation
  - Record headings from 2+ points surrounding source
  - Multipath is easily noticeable

Triangulation



Multipath

- Noted by odd bearings and wavering signal strengths
- Caused by reflections



Getting Closer

- Multipath Effects are lessened but transmitter becomes overpowering
  - Fading techniques and directional antennas suffer
  - Doppler/Adcock Arrays prevail
- Attenuation
  - Active vs. Passive Attenuation
  - Harmonics

Attenuation

- Resistive Attenuation
  - Weakens SNR
  - Prone to signal leakage
- Offset Attenuator (pictured)
  - Changes frequency in small amounts
  - Offers up to 100 dB attenuation
- Harmonics
  - For 2m transmitters, tune to 3rd harmonic
  - 40-80 dB

Other Caveats

- Desense
  - When strong, nearby transmitters overdrive receiver's front end
- Intermodulation
  - When multiple nearby transmitters
  - Common in RF dense areas

Books & Links

- *Transmitter Hunting: Radio Direction Finding Simplified*
  - Joe Moell and Thomas Curlee
- http://homingin.com/
- IARU Region II ARDF Site
  - http://www.ardf-r2.org/
- Tape Measure Beam Plans
  - http://theleggios.net/wb2hol/projects/rdf/tape_bm.htm
- Offset Attenuator Plans
  - http://www.homingin.com/joek0ov/offatten.html
- This Presentation
  - http://goo.gl/Qa34T