FOX Hunting Basics

Dave W8RZA

FOX Hunting Basics

Steps in a transmitter hunt

- Signal acquisition
- Triangulation
  - Plot bearings on map to get an estimated direction of the transmitter
- Homing
  - "follow your nose"
- Sniffing
  - Up close and personal

FOX Hunting Basics

Following Clues

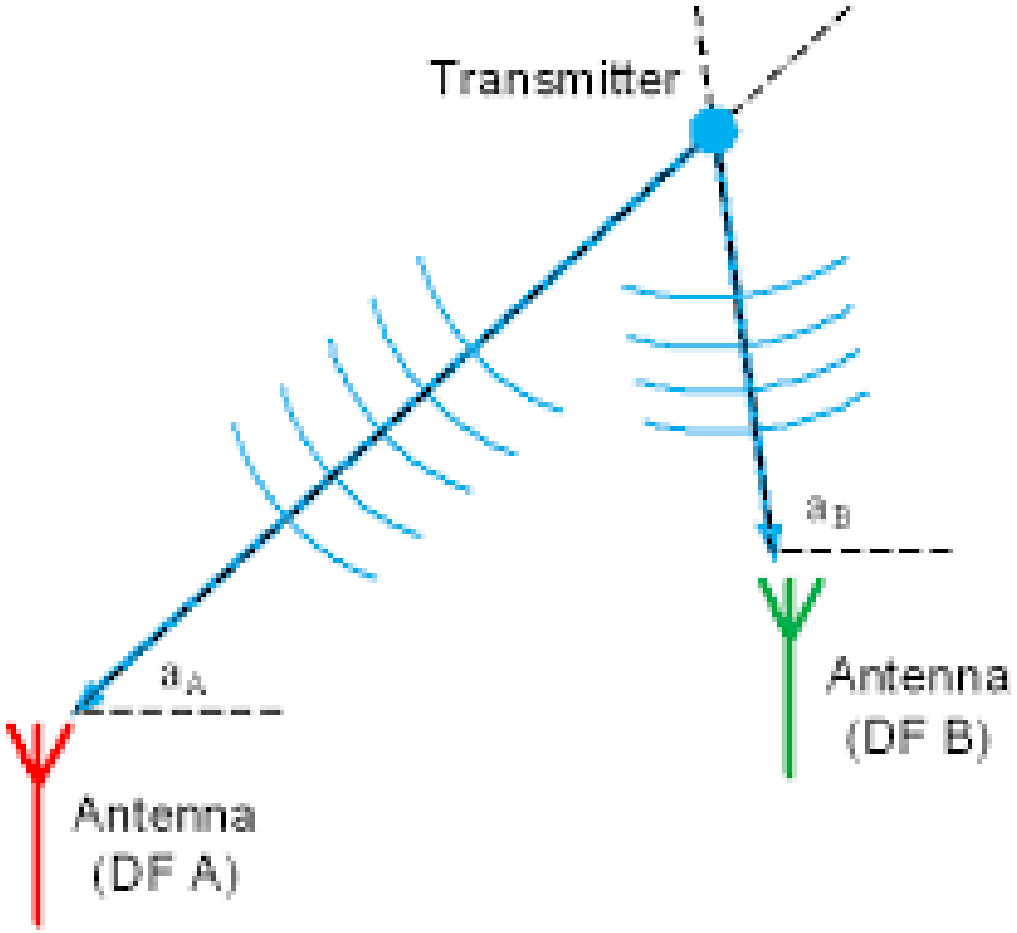
- Finding the transmitter is a process of following clues to the source of the signal. Important clues include:
  - –Direction
  - –Signal Strength
  - –Rate of change in direction
  - –Rate of change in signal strength
  - –Terrain shadowing
  - –Non-radio clues: keep your eyes open!

FOX Hunting Basics

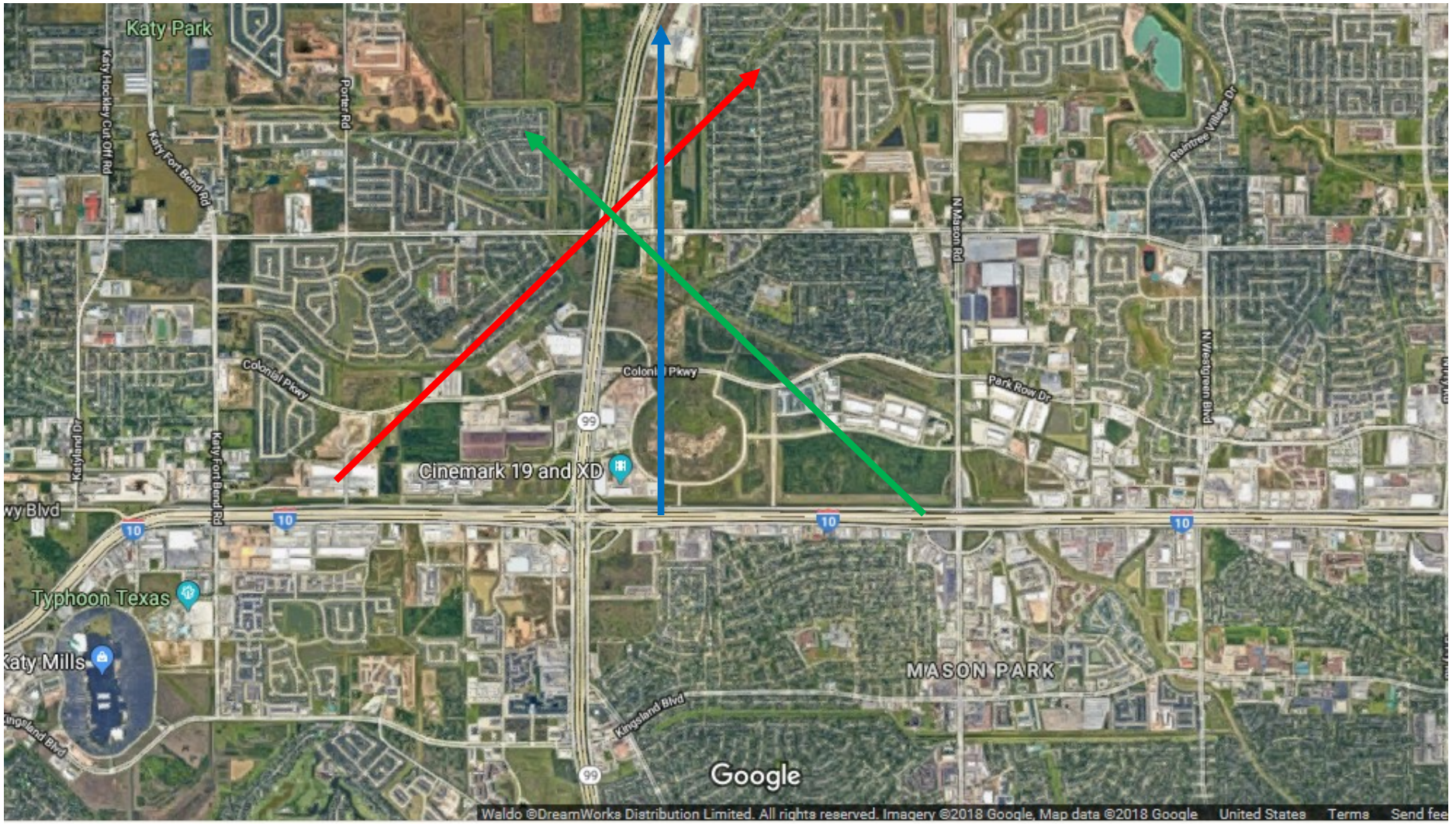
Tools for Determining Direction

- Antenna with directional pattern
- Some way to measure signal strength
- Some way to reduce signal strength as you get close to avoid receiver overload –"Attenuator"

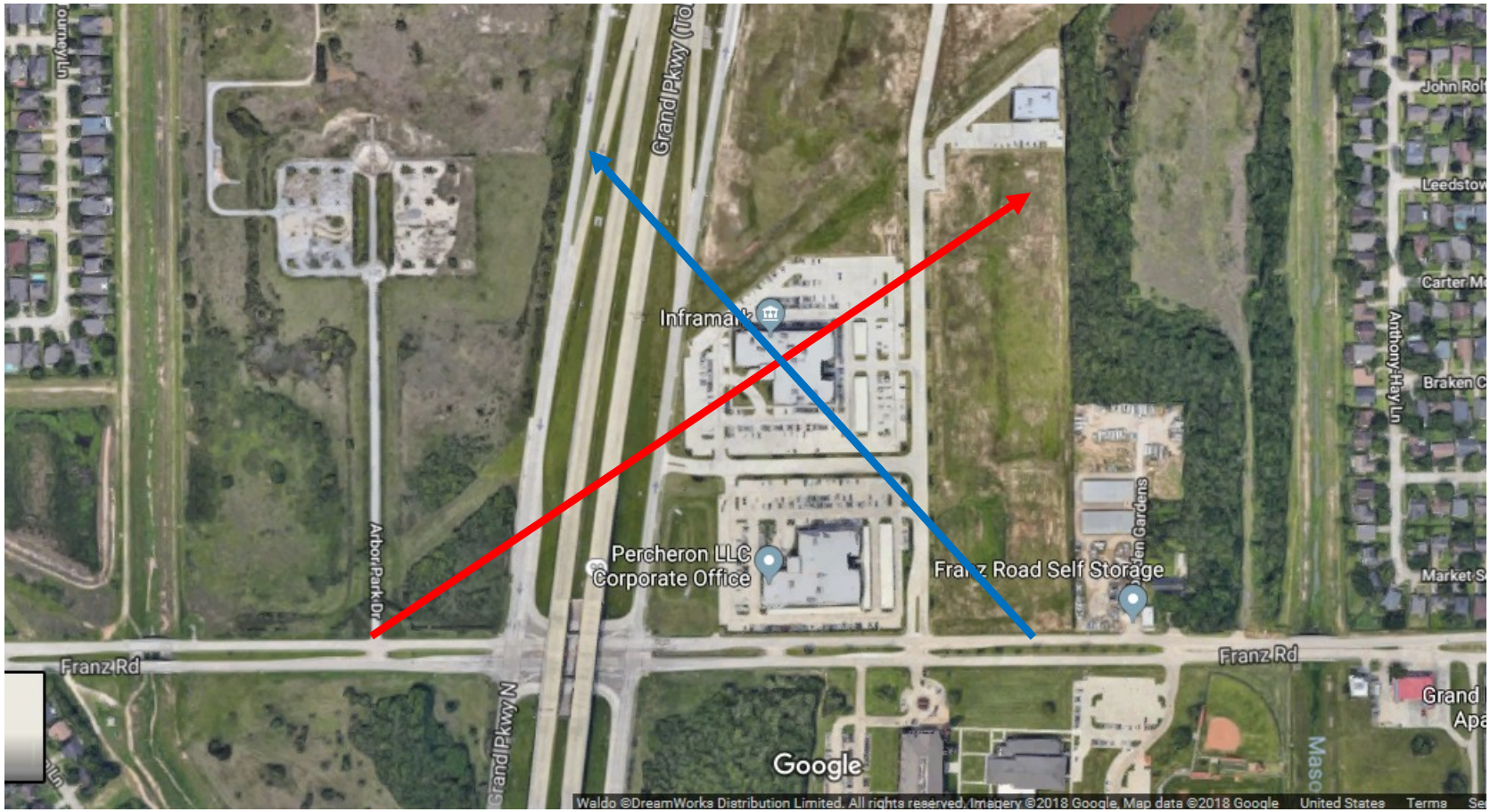
Bearings



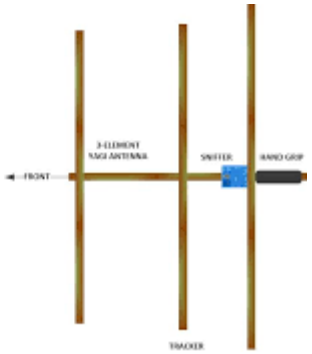
Bearings


Katy Park
Katy Hockley Cut Off Rd
Porter Rd
Katy Fort Bend Rd
Colonial Pkwy
Cinemark 19 and XD
99
10
Typhoon Texas
Katy Mills
Kingsland Blvd
MASON PARK
Google
N Mason Rd
Park Row Dr
N Westgreen Blvd
Waldo ©DreamWorks Distribution Limited. All rights reserved. Imagery ©2018 Google, Map data ©2018 Google United States Terms Send fee

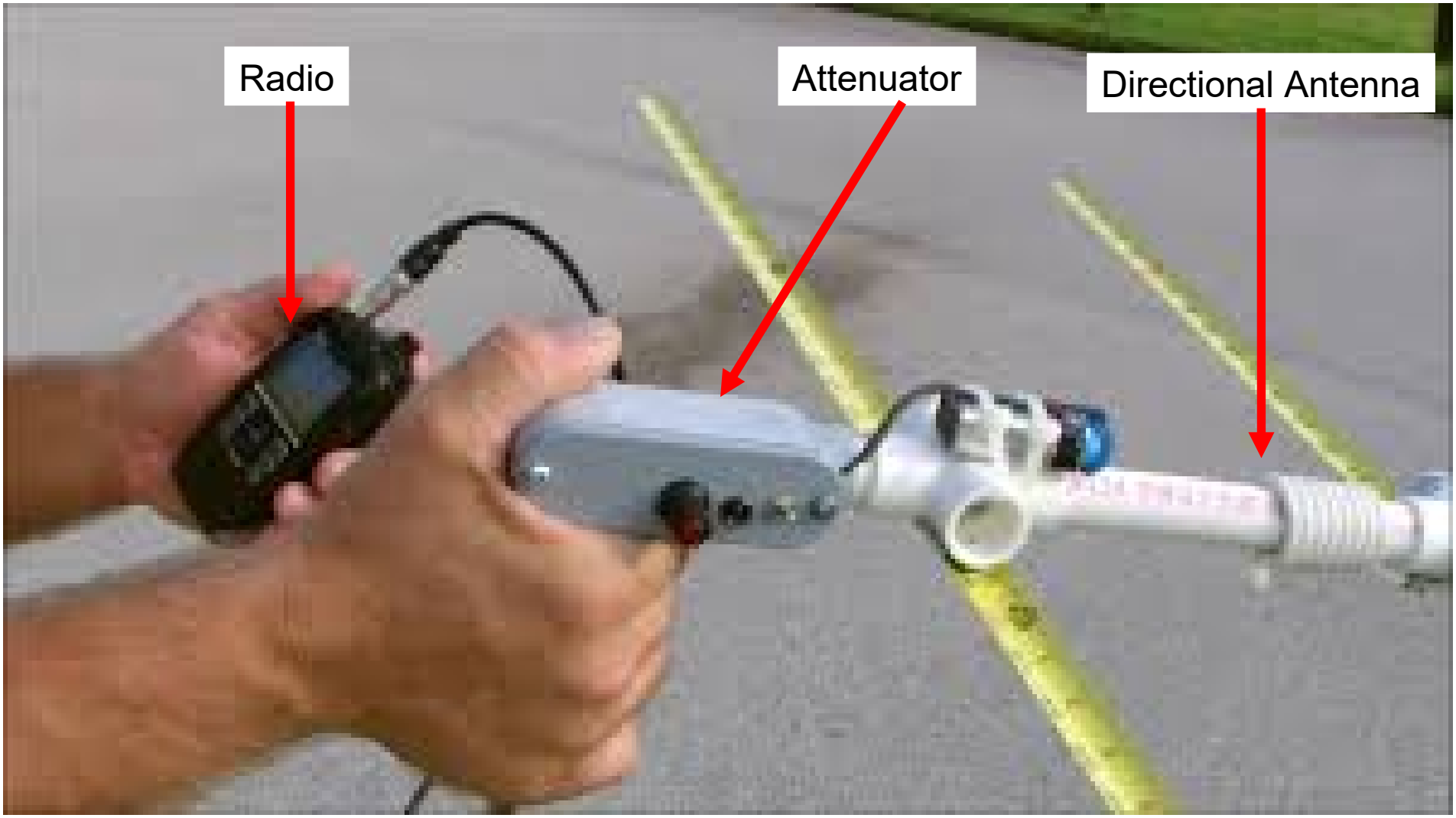
Bearings


Grand Pkwy
Percheron LLC
Corporate Office
Franz Road Self Storage
Franz Rd
Arbor Park Dr
Grand Pkwy N
Anthony Hay Ln
Google
Waldo ©DreamWorks Distribution Limited. All rights reserved, Imagery ©2018 Google, Map data ©2018 Google United States Terms

Equipment Used for DF'ing

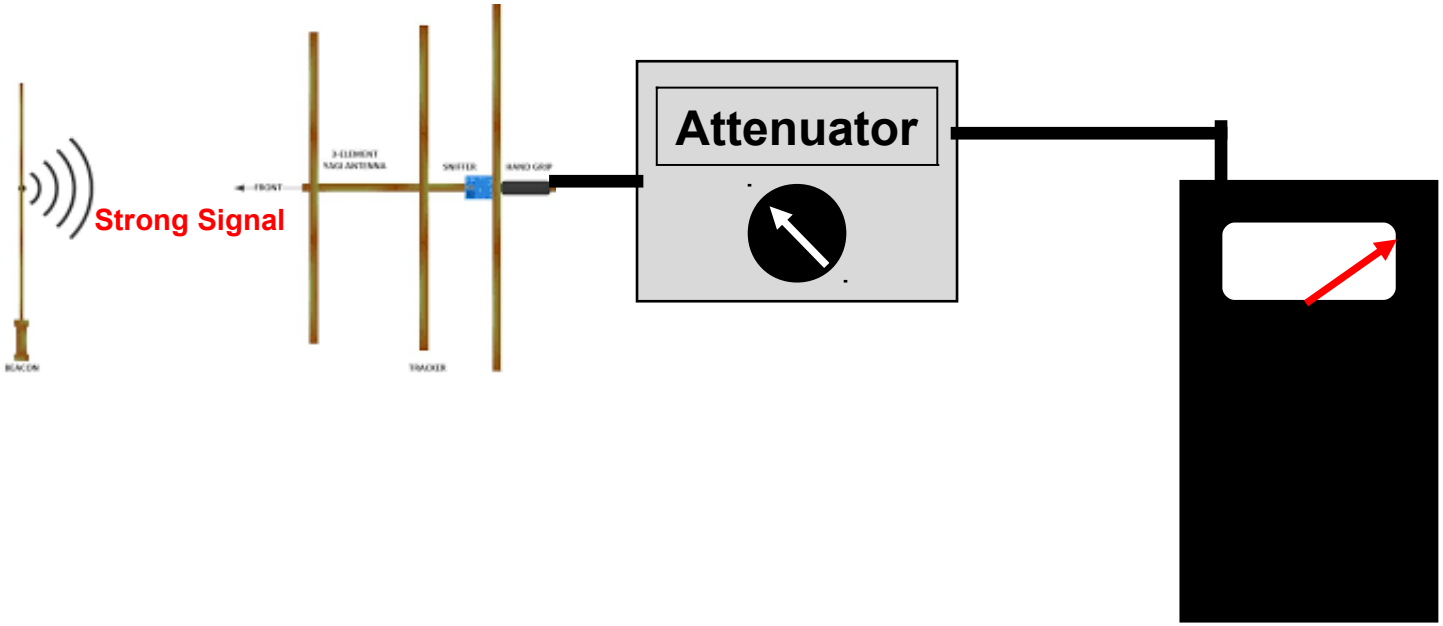


Equipment Used for DF'ing



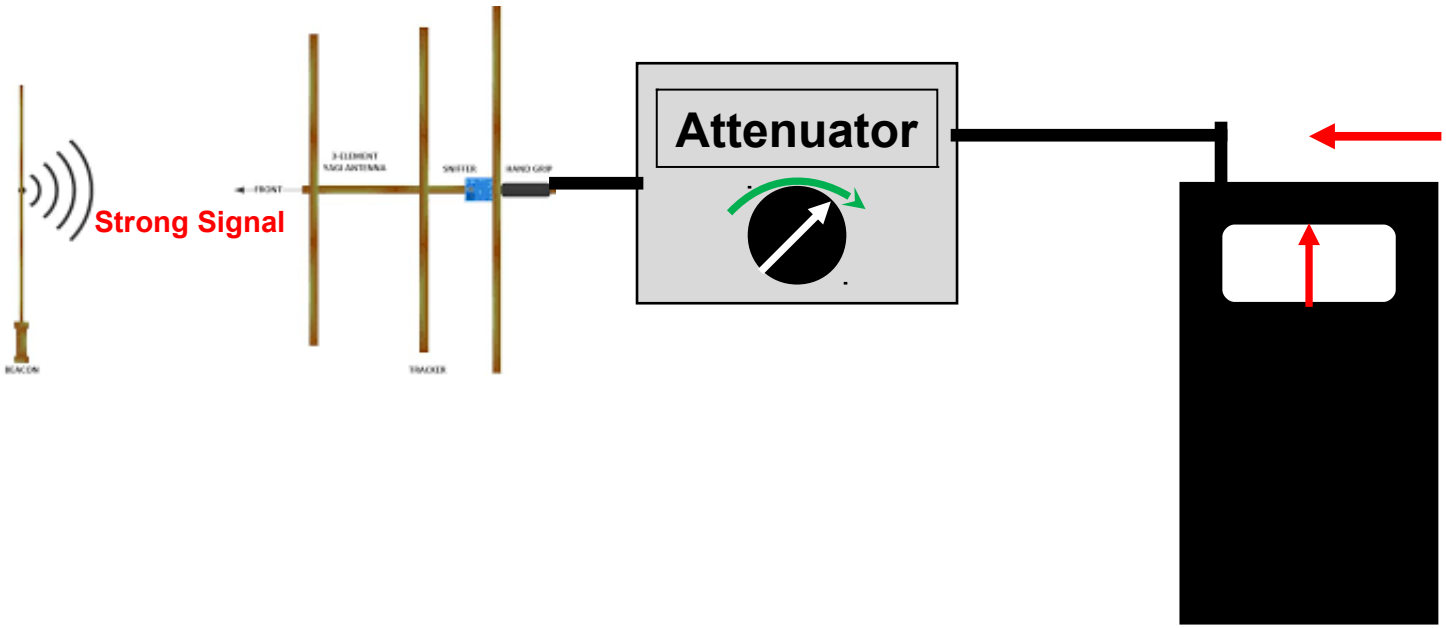
Equipment Used for DF'ing

The attenuator is used to reduce signals so the S meter is in the middle of the scale in the presence of a strong signal



Equipment Used for DF'ing

The attenuator is used to reduce signals so the S meter is in the middle of the scale in the presence of a strong signal



Equipment Used for DF'ing

Time Difference of Arrival TDOA

Equipment Used for DF'ing

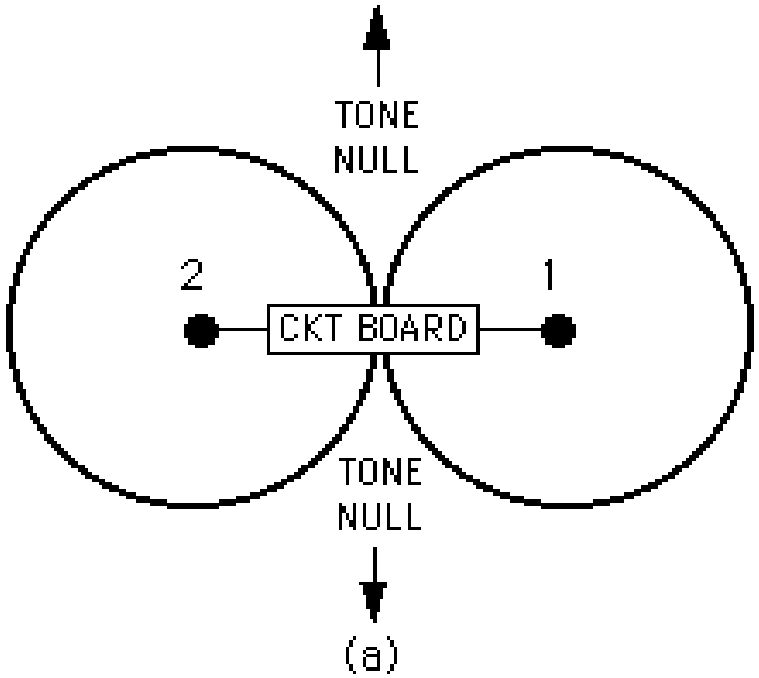
Time Difference of Arrival TDOA

How it works

- Time Difference of Arrival RDF sets work by switching your receiver between two antennas at a rapid rate. When both antennas are the same distance from the transmitter, the RF phase received by both antennas will be identical.
- If the two antennas are different distances from the transmitter the RF will have a different phase at each antenna.
- If we switch between the antennas 500 times a second, this phase change will be detected by an FM receiver as a 500 Hz tone. By turning the antennas for a null in the tone, your two antennas will be perpendicular to the transmitter. Unfortunately, you can be facing the transmitter or facing away from the transmitter and get a null in the tone.
- This circuit does not give you the ability to know if you are facing the transmitter or facing away from it. You must use triangulation to determine the correct direction.
- If using an HT, be careful ***not*** to transmit while using a TDOA device.

Equipment Used for DF'ing

Time Difference of Arrival TDOA



In this view looking down from the sky, the bidirectional HANDI-Finder unit (a) has two nulls, each perpendicular to the plane of the antennas.

Equipment Used for DF'ing

Loop Antennas

Equipment Used for DF'ing

Loop Antennas

- Loop antennas are the simplest design for DF'ing
- While rotating the loop you will see peaks and nulls
- The peaks indicate the direction of the transmitter
- Once you get your initial bearing, you will need to get a second bearing to determine if the transmitter is in front or behind you
- With a sense antenna attached to the loop there is a more cardioid pattern that is a better indicator of direction of the transmitter
- An attenuator should be used to knock down a strong signal so you can determine the direction of the transmitter with more accuracy

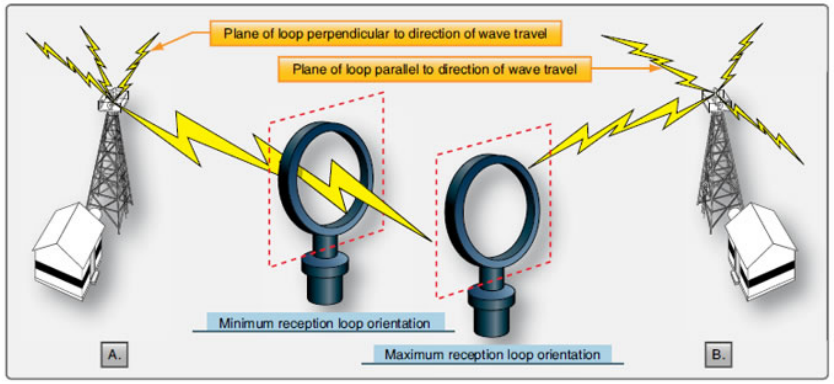
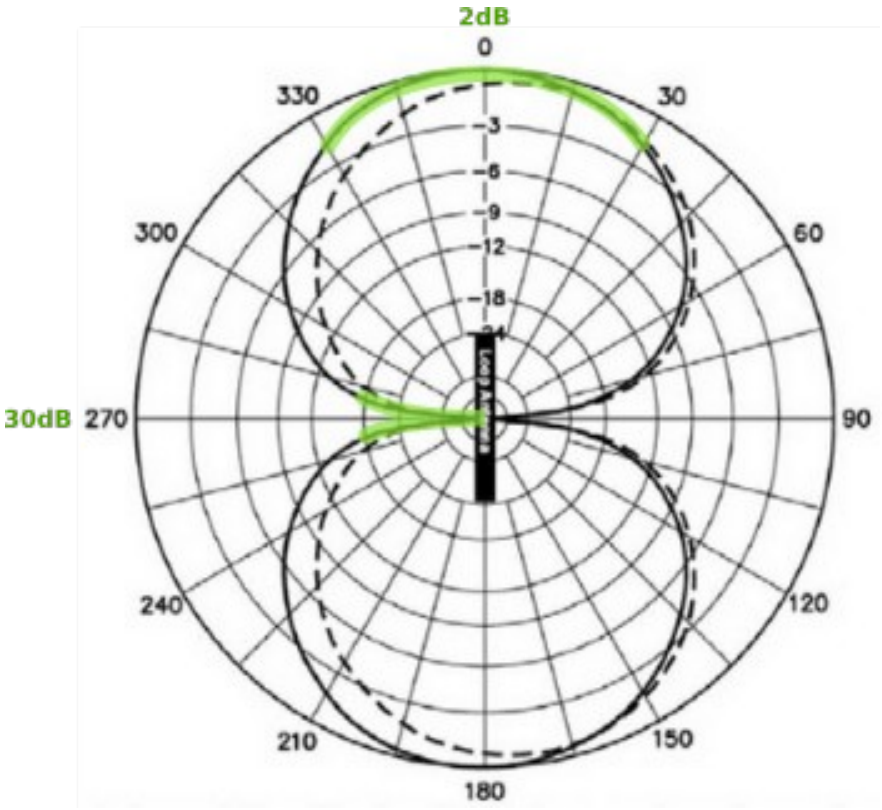
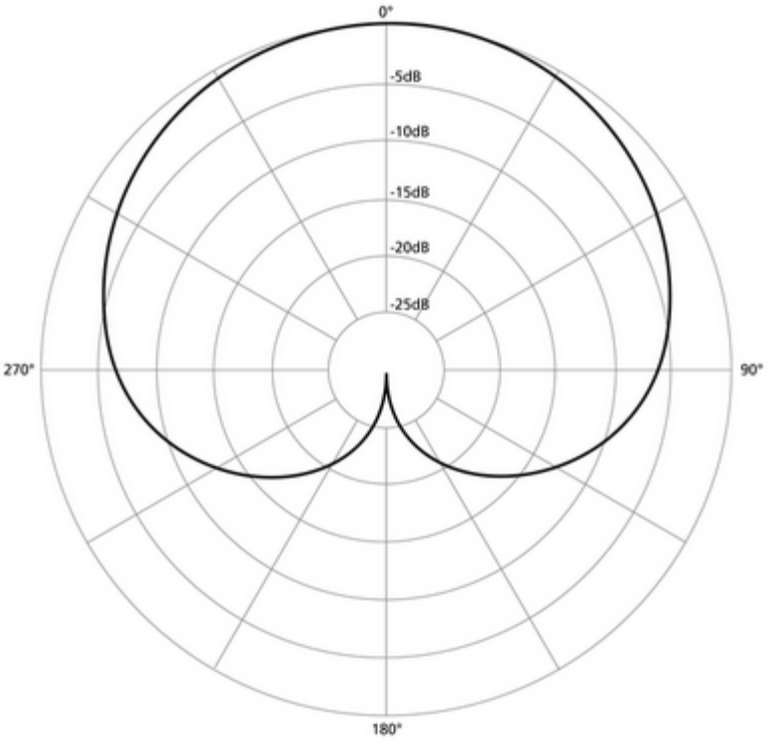


Figure 11-93. *A loop antenna is highly direction-sensitive. A signal origin perpendicular or broadside to the loop creates a weak signal (A). A signal origin parallel or in the plain of the loop creates a strong signal (B).*

Equipment Used for DF'ing

Loop Antennas





W/Out Sense Antenna

With Sense Antenna

Equipment Used for DF'ing

Techniques Used to Sniff Out the Transmitter

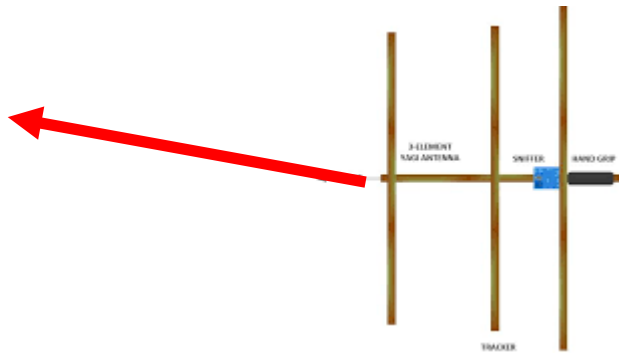
- When close to the transmitter use maximum attenuation
- If the receiver is still overloaded, remove the antenna. As you move close to the transmitter you will overload the receiver again and you should be within visual distance of the Fox
- Using your body to null out the signal is another technique. By holding the HT against you body and turning around slowly the signal should drop off indicating the transmitter is behind you.
- If using a Yagi antenna you can attenuate the signal by changing polarization of your antenna. If the signal is vertically polarized, turn the antenna 45 deg and that will give a 3 dB reduction in the signal. Turn it horizontal and it will reduce the signal by 20 dB.
- If your receiver is overloaded you can tune it off frequency by 5 to 10 KHz and effectively reduce the signal strength.

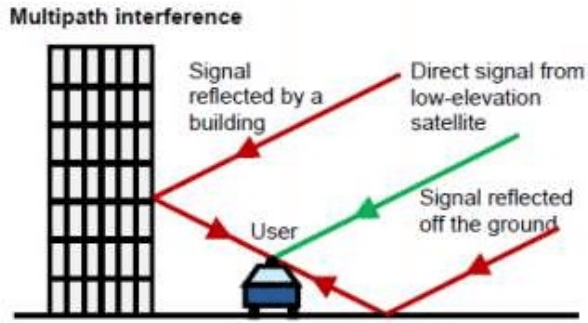
Equipment Used for DF'ing

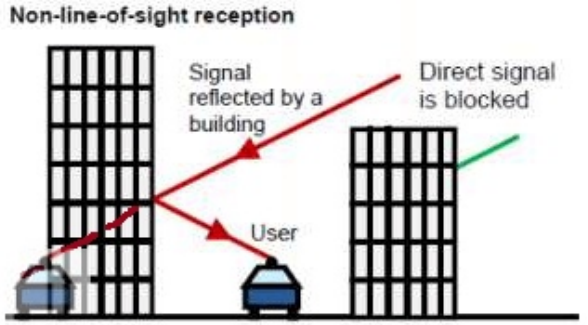
Techniques Used to Sniff Out the Transmitter

- **Regardless of the type of antenna used always check a bearing against a transmitter in a known location. Most antennas often have an offset that may not point exactly where you think its pointed. It can be off several degrees right or left from straight ahead.**
- **When taking a bearing, try to avoid metal structures and buildings that cause "Multi-path" signals.**

Offset







Equipment Used for DF'ing

Doppler Units

Equipment Used for DF'ing

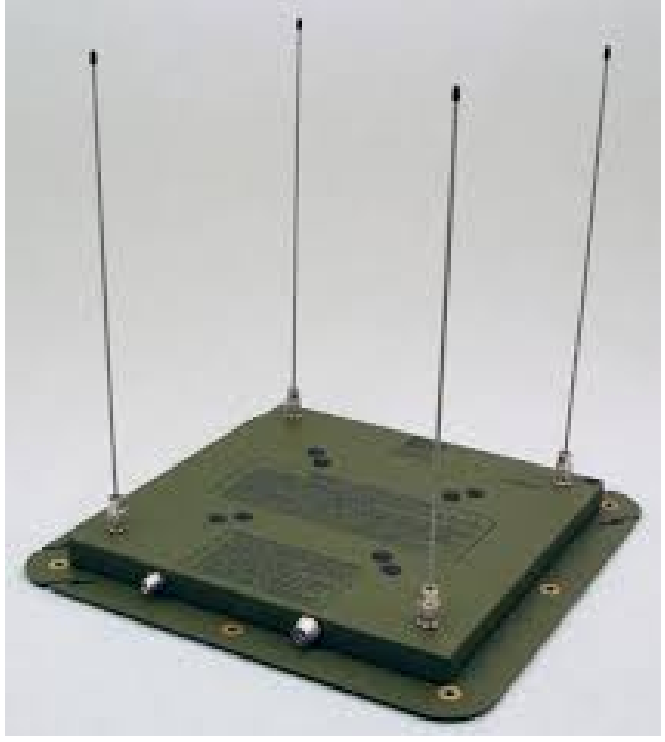
Doppler Units

Doppler units use the principle of electronically spinning the antennas by turning them on one at a time at a high rate of speed and when a signal is detected a corresponding LED lights up on the display unit indicating the direction the signal is coming from.

Equipment Used for DF'ing

Doppler Units

The Doppler unit uses an antenna array with four antennas. The antennas are connected to the summer box that is connected to the Doppler unit.

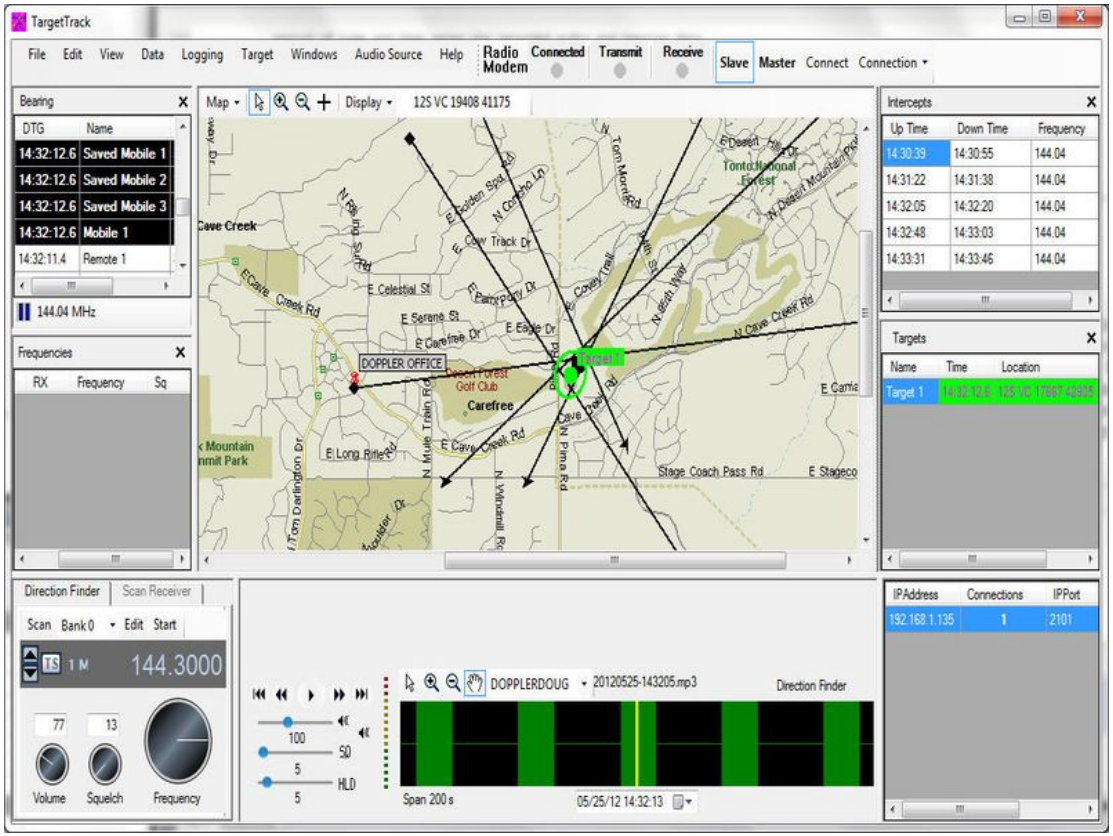


While using a Doppler do not transmit through the unit or use a transmitter near the antenna array or you might damage the unit or the pin diodes in the array.

Equipment Used for DF'ing

Doppler Units

Newer units even plot the bearings on a map



Real World Uses for Direction Finding

- **Locating Jammers**
- **Stuck mics**
- **Downed aircraft- EPIRB's**
- **Fox hunts**
- **Noise interference- electrical noise, power line noise**

Real World Uses for Direction Finding

Emergency Services – Ground

- Ground Search and Rescue
- Lost or missing person searches
- Wide Area Search
- Air – Ground coordination
- Ground Direction Finding of ELT, EPIRB, PLB
- Search management
- Damage assessment

Real World Uses for Direction Finding


POWER
ICOM
IC-W32A
FM TRANSCEIVER
MAIN
435.77-460.15
SCAN
DTMF
MHz
SKIP
LOCK
MW


HOUSTON
POLICE
POLICE

Conclusion

Fox hunts are a lot of fun and gives us a chance to practice our skills tracking down transmitters and interference. By knowing our equipment and the techniques as described here, we have a good foundation for transmitter hunting.

Links:

Handi Finder TDOA- http://www.handi-finder.com/
http://www.three-peaks.net/handi-finder.pdf

Tape measure Yagi-
http://www.instructables.com/id/Radio-Direction-Finding- Antenna-for-VHF/

Loop Antenna- http://users.tpg.com.au/ldbutler/VHFLoopAntenna.htm

Attenuator- http://blog.novaeletronica.com.br/en/tabela-de-atenuador-de-rf-com-resistores/