

# FOX Hunting Basics



# **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:

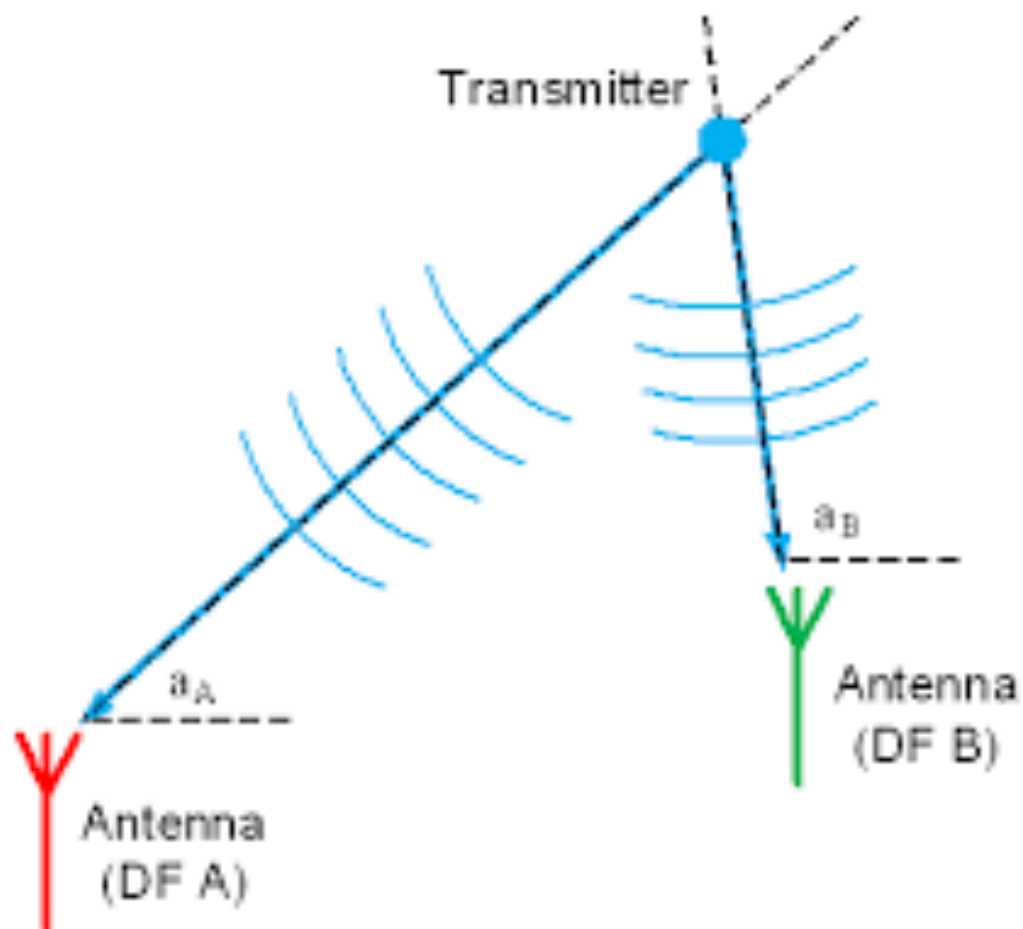
- Direction
- Signal Strength
- Rate of change in direction
- Rate of change in signal strength
- Terrain shadowing
- Non-radio clues: keep your eyes open!

# **FOX Hunting Basics**

## **Tools for Determining Direction**

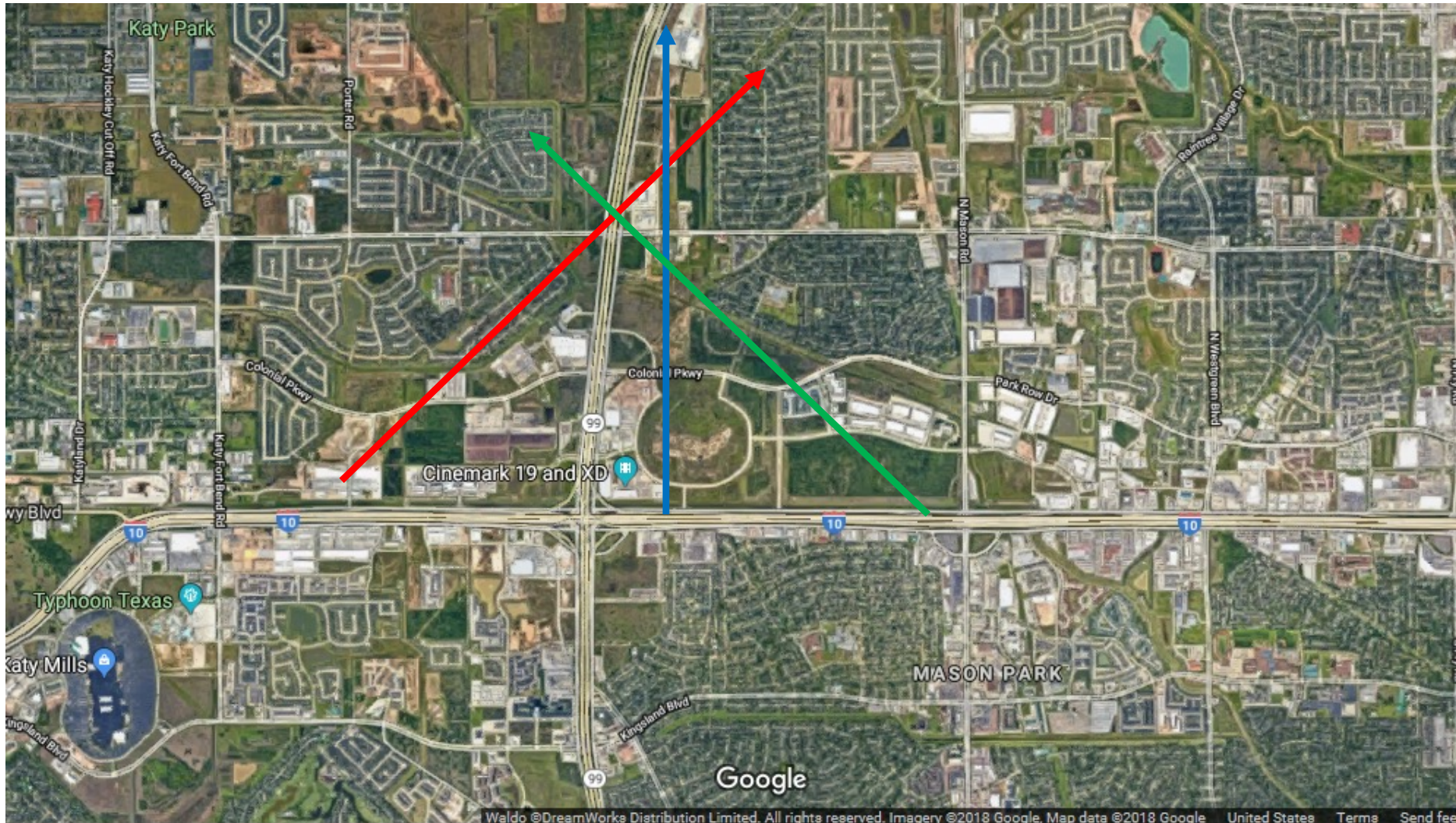
- Antenna with directional pattern
- Some way to measure signal strength
- Some way to reduce signal strength as you get close to avoid receiver overload  
—“Attenuator”

## Bearings



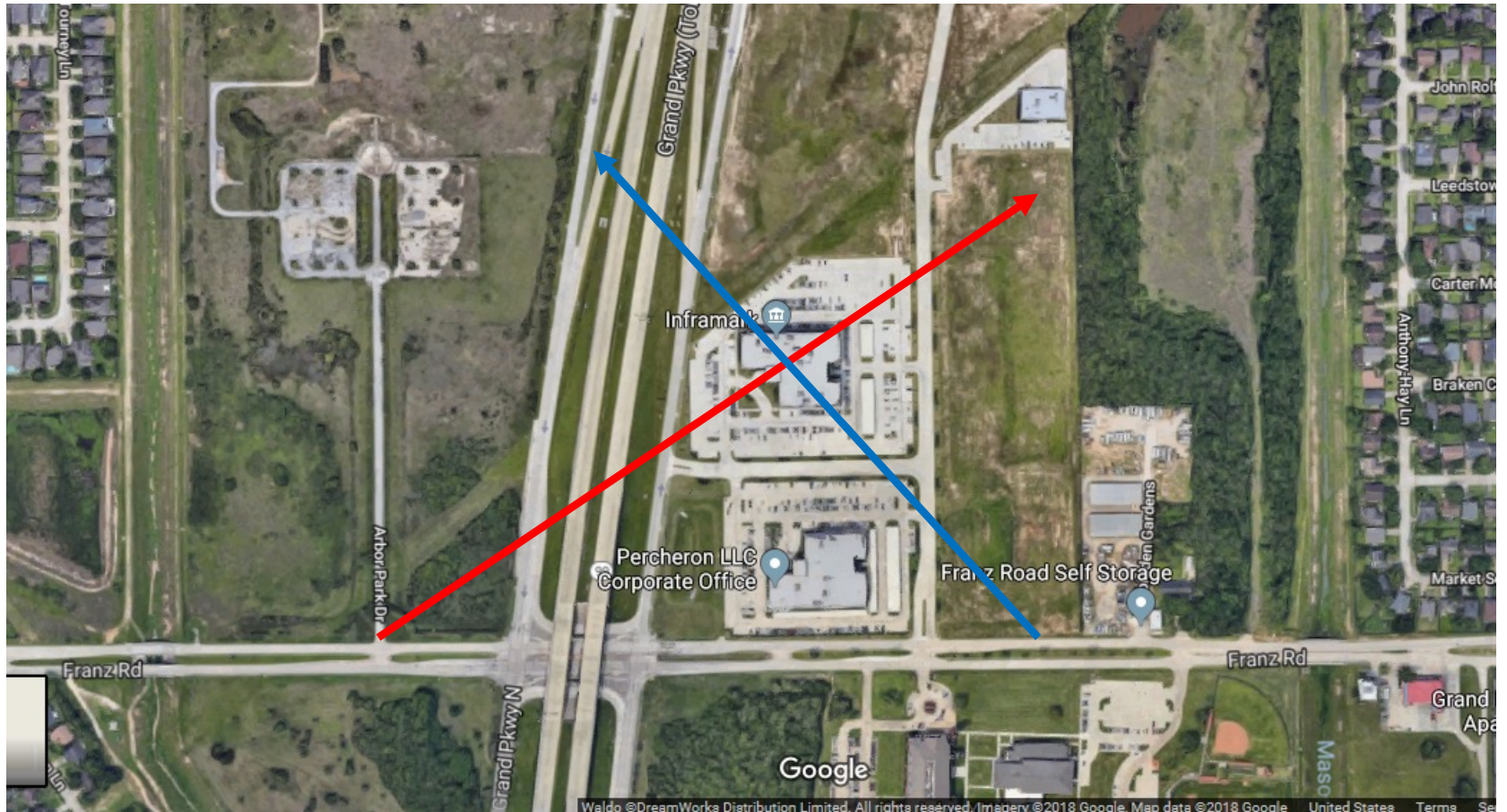


## Bearings

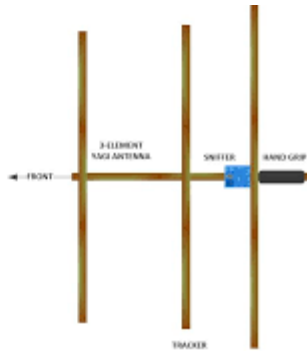




## Bearings



## Equipment Used for DF'ing



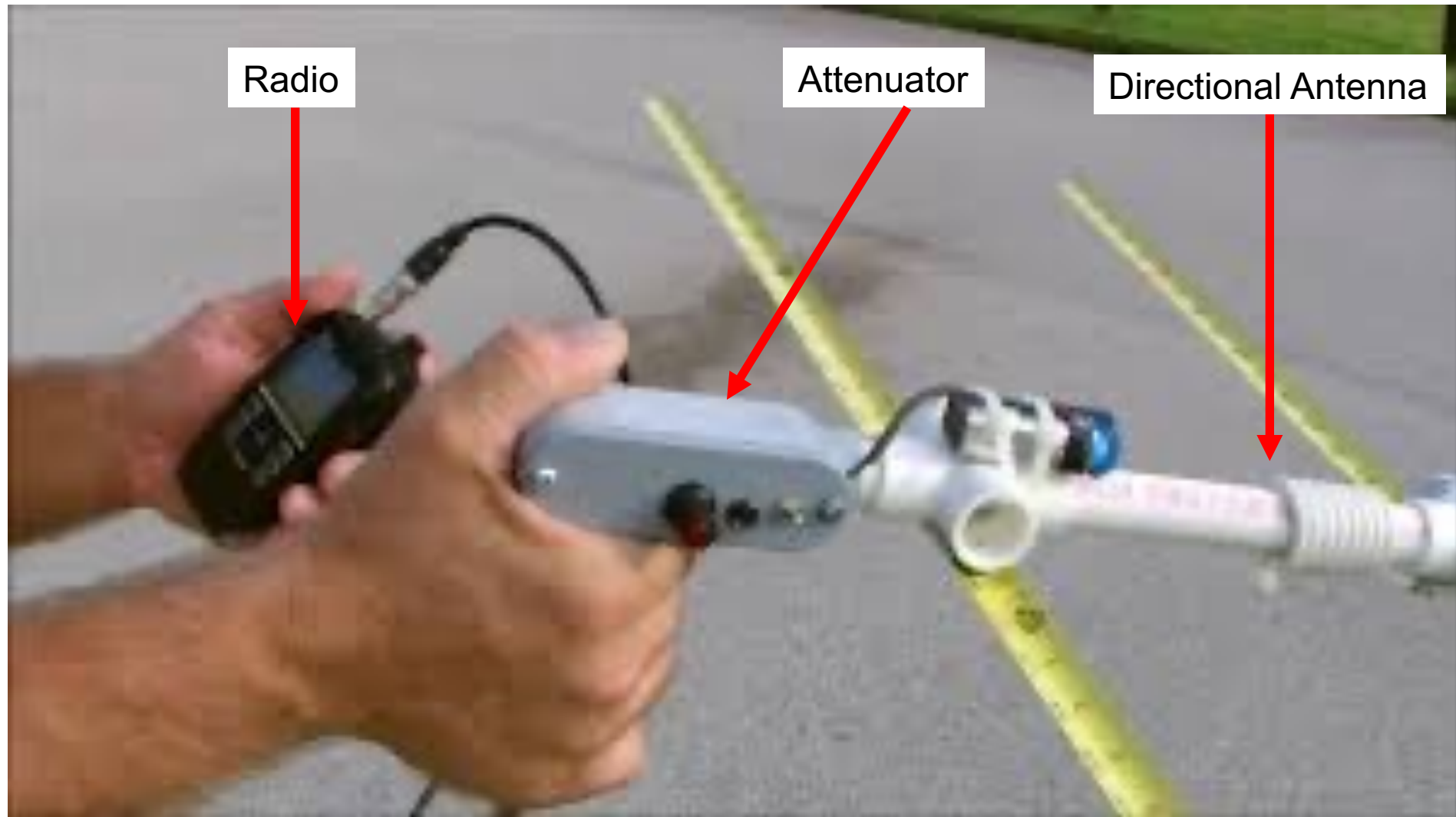


## Equipment Used for DF'ing

Radio

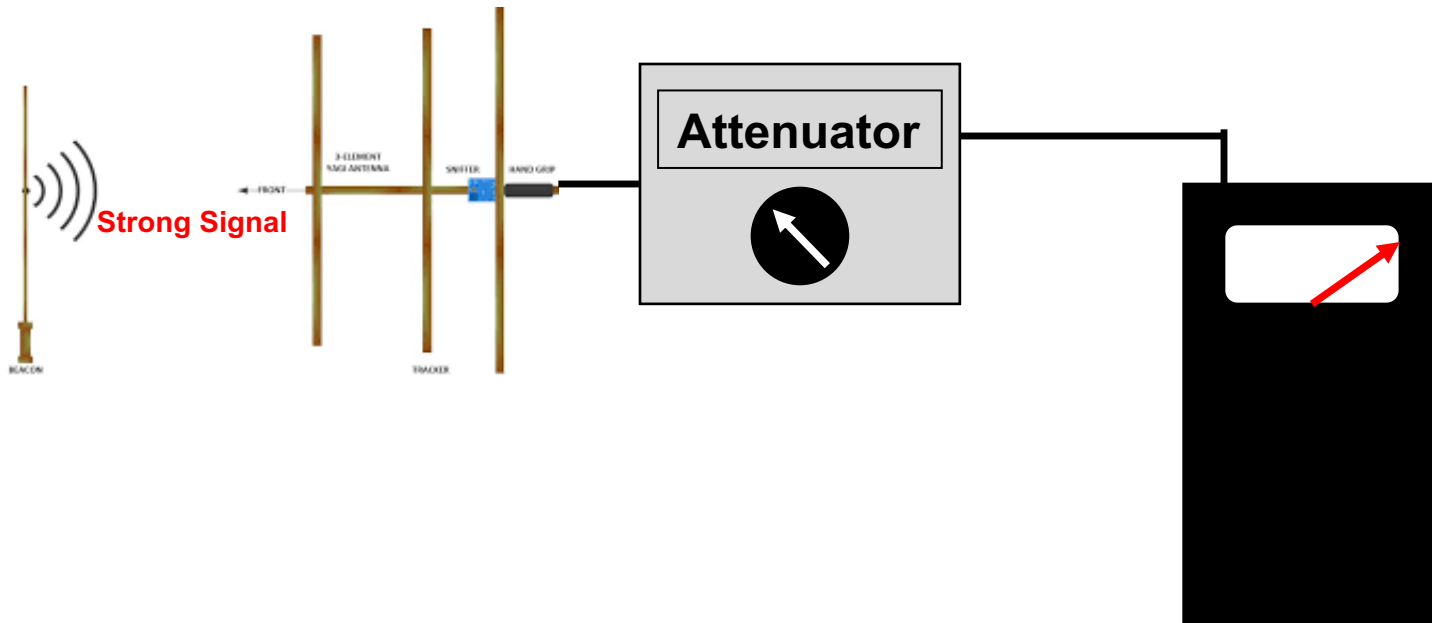
Attenuator

Directional Antenna



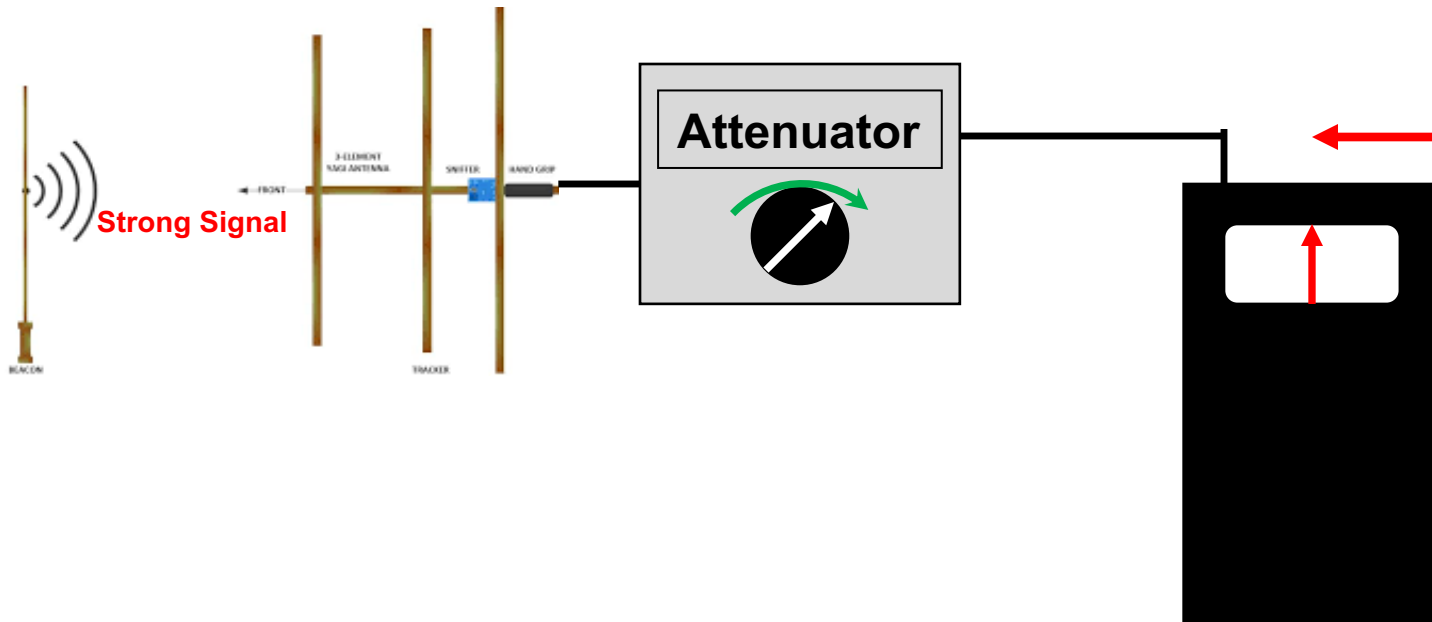
## Equipment Used for DF'ing

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



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## Equipment Used for DF'ing

### Time Difference of Arrival TDOA



## Equipment Used for DF'ing

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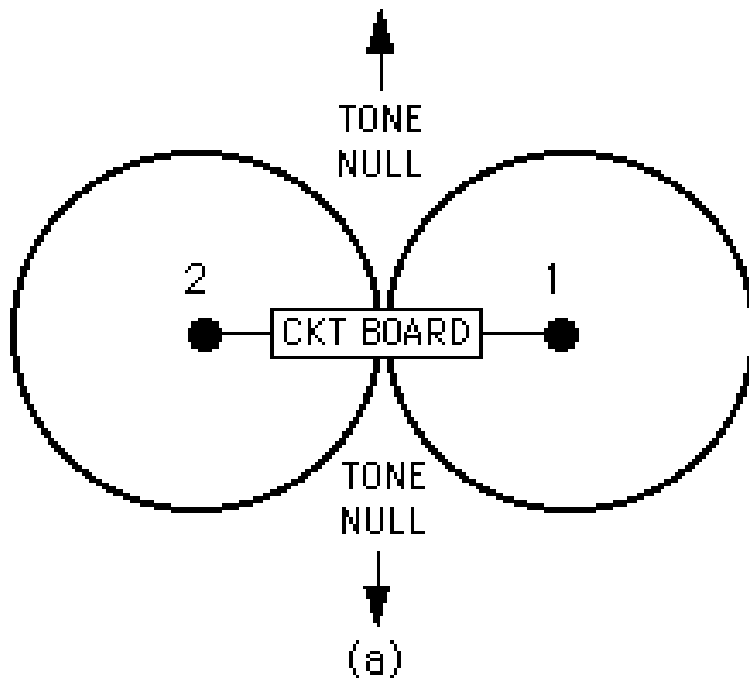
#### How it works

- 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

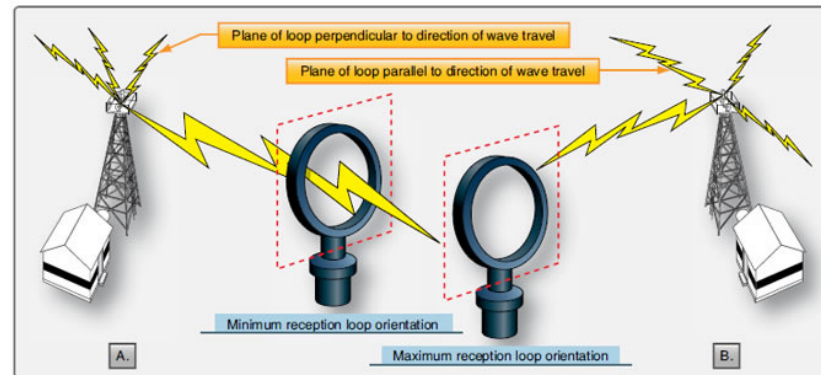
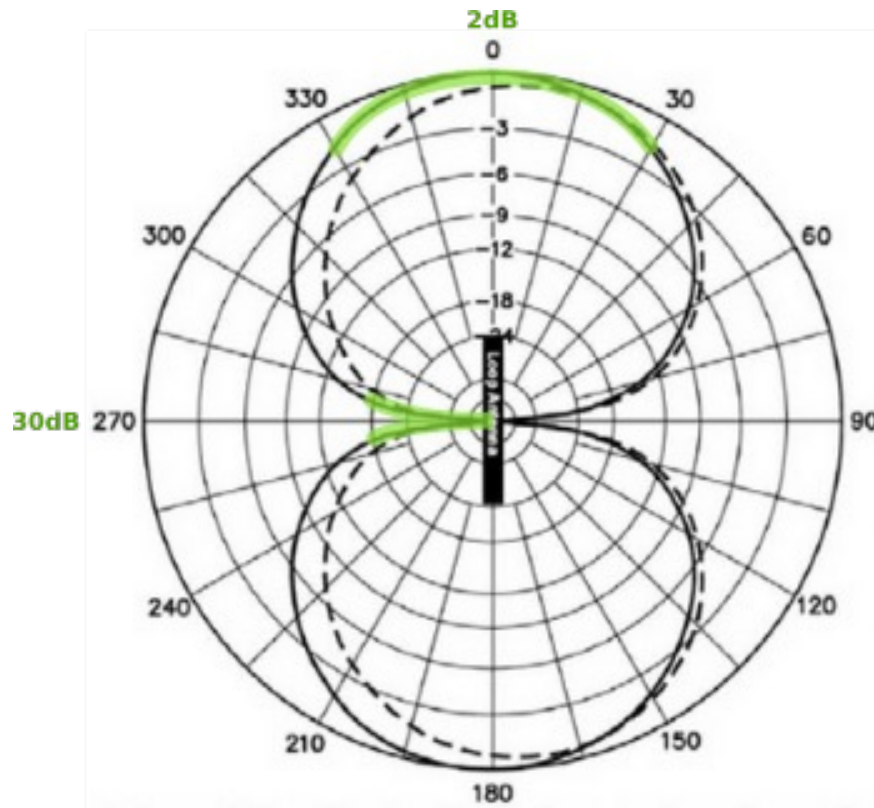


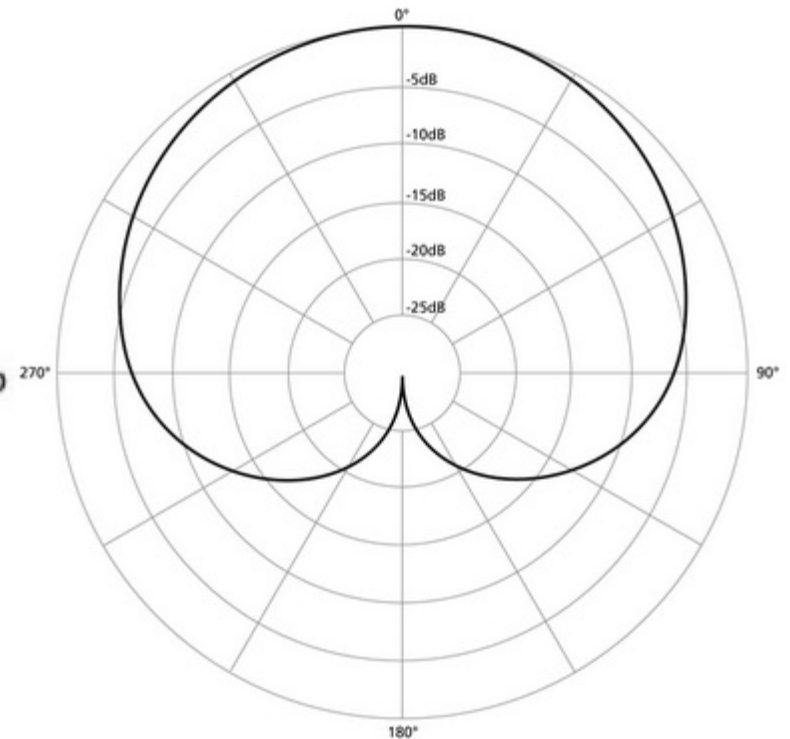
Figure 11-93. A loop antenna is highly direction-sensitive. A signal origin perpendicular or broadside to the loop creates a weak signal (A). A signal origin parallel or in the plane of the loop creates a strong signal (B).

## 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.**

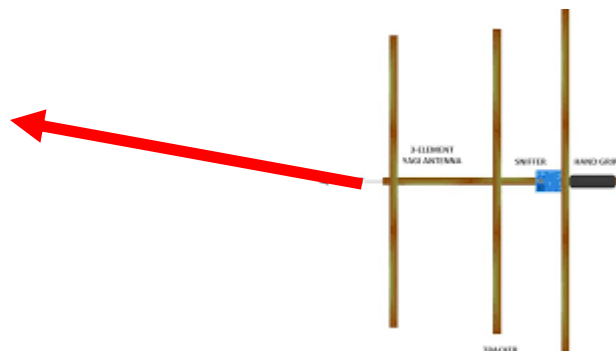


## Equipment Used for DF'ing

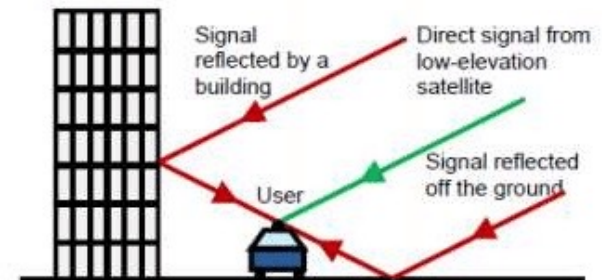
### Techniques Used to Sniff Out the Transmitter

- 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.

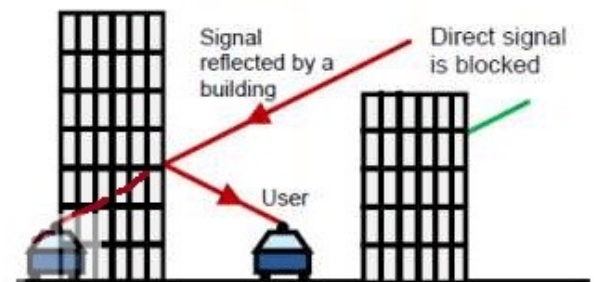
Offset



Multipath interference



Non-line-of-sight reception



## Equipment Used for DF'ing

### Doppler Units



## Equipment Used for DF'ing

### Doppler Units

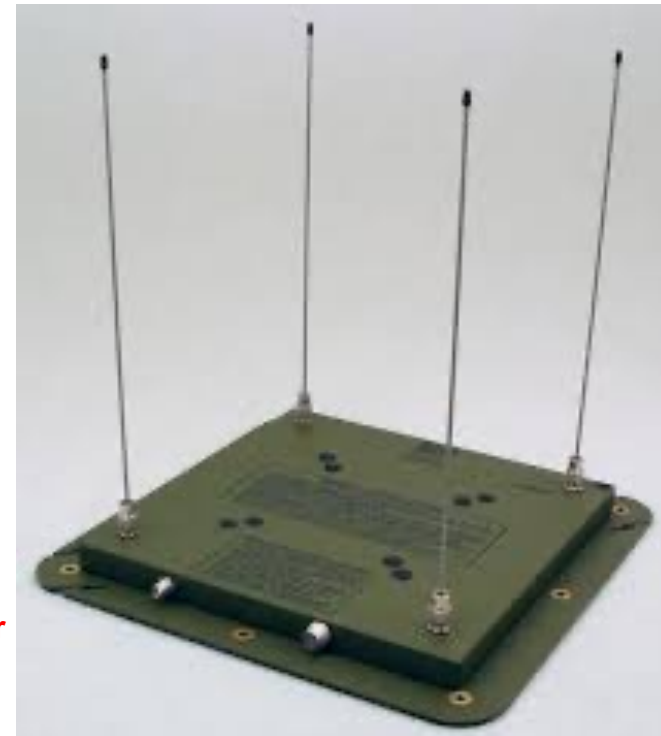
Doppler units use the principle of electronically spinning the antennas by turning them on one at a time at a high rate of speed and when a signal is detected a corresponding LED lights up on the display unit indicating the direction the signal is coming from.



## 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.

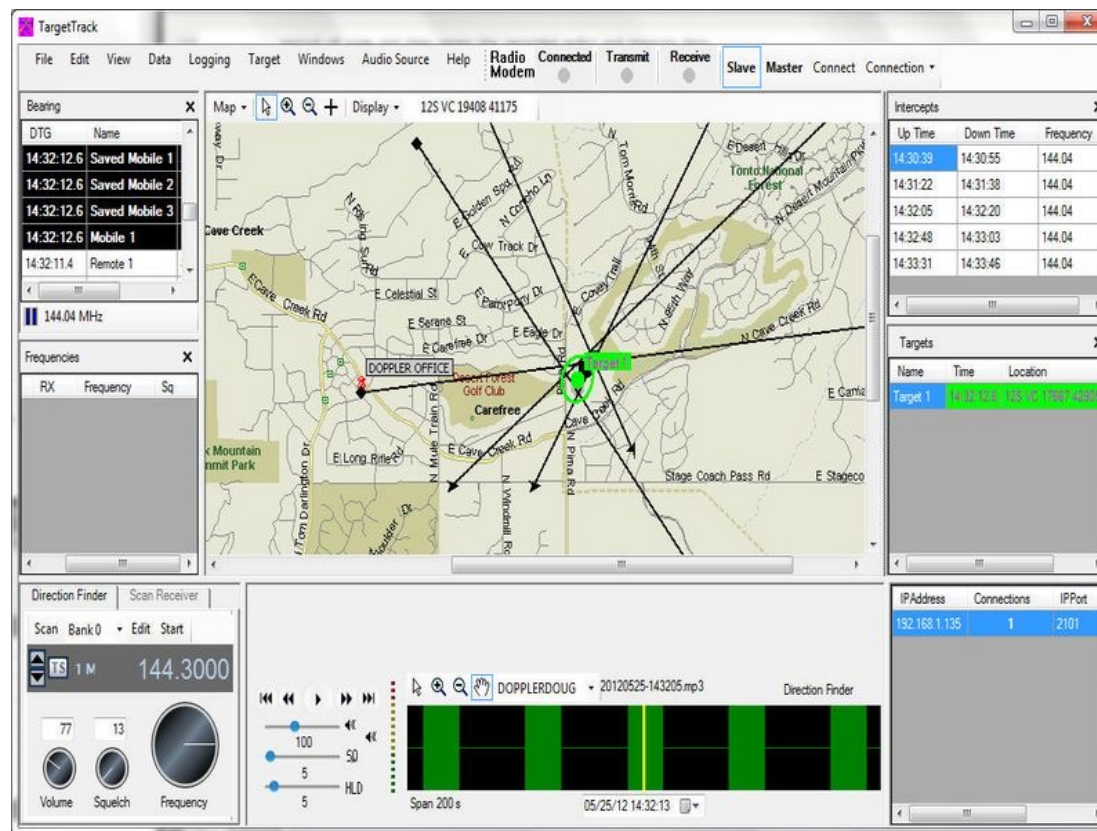


**While using a Doppler do not transmit through the unit or use a transmitter near the antenna array or you might damage the unit or the pin diodes in the array.**

# 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



The screenshot shows the homepage of khou.com, a local news website. The header features the khou.com logo with the tagline "CONNECTING YOU TO WHAT MATTERS." and a search bar. Below the header is a navigation menu with links to News, Weather, Traffic, Sports, Entertainment & Lifestyles, Your Photos & Video, Women's Connection, and Channel 11. The main content area is titled "CRIME" and features a news article. The article's title is "HPD: Man jammed police radios with racism, profanity", dated "07:13 AM CST on Tuesday, February 13, 2007". The article is attributed to "From 11 News staff reports" and describes the arrest of a man who jammed police radios with racist remarks and profanity. It also mentions that Michael McCollum was arrested after a year-long investigation and that police tracked the signal using a ham radio. The article concludes by stating that police also arrested Larry Lewis, who was connected to the illegal broadcasts and found in a stolen car.

**khou.com**  
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Home Search GO

News Weather Traffic Sports Entertainment & Lifestyles Your Photos & Video Women's Connection Channel 11

**News**

- Local News
- 11 News Investigates
- Texas
- Nation - World
- Crime**
- Education
- Politics / Elections
- Business
- Technology
- Web Links
- Weird News
- News Video
- E-mail Alerts
- Message Boards
- Crime Blotter

### CRIME

## HPD: Man jammed police radios with racism, profanity

07:13 AM CST on Tuesday, February 13, 2007

**From 11 News staff reports**

Houston police arrested a man who they said has jammed their radios with racist remarks and profanity.

Michael McCollum was arrested after a year-long investigation.

Police said he repeatedly used a ham radio to interrupt police transmissions. The FCC tracked the signal and helped find him.

Police also arrested Larry Lewis, who they said was connected to the illegal broadcasts. He was found in a stolen car.











## **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/>**