Mentoring for fun

Mentoring for fun

- What makes you happy?
- VHF / UHF
- HF
- Fox Hunting
- Internet linking / Kit Building
- Packet
- Satellites
- Talking on the radio
- Emergency Communications

RF Direction Finding (AKA Fox Hunting)

- Find the hidden transmitter – requires observation and a little imagination
- Build the fox hunt receiver antenna, regular antennas are too sensitive
- Any 2meter or dual band radio can work
- Byonics makes Fox Hunt radio transmitters
- People of many ages and skill levels can participate
- This is one of the most enjoyable activities due to its simplicity.
- Yet can cover a wide range of difficulty.

Internet Linking (HF / VHF / UHF)

- Parts of this type of activity is geared for the more technical astute population, but other parts can be done with little to no technical ability.
- Per FCC Rules – none of the transmissions are encrypted
- IRLP – Interconnect stations/repeaters via the internet (Very technical)
- Echo Link – Connect to registered stations / repeaters from your computer or smart phone (not technical)
- Web SDR – Listen to HF radio stations with out registration (not technical) – transmit with subscription (Very technical and can be expensive depending on transmitting station complexity – Flex Radio)
- D Star (ICOM, Kenwood) – digital radio communication format – proprietary IP - may require registration into a data base system - (Somewhat technical)
- DMR (low cost Chinese) – digital radio communication format – proprietary IP - may require registration into a data base system - (Somewhat technical)
- System Fusion (Yeasu) – digital radio communication format – proprietary IP - (Somewhat technical)
- M17 (Connect Systems) – Open-Source digital protocol / IP – at least one company has radios in market
  Bay Area repeater is functional – W6CX – 145.000MHz (Mt Diablo)
- K8JTK Hub: Digital VoIP Mutimode Interlink System | Jeffrey Kopcak, MBA – K8JTK

Packet Communications

- Used for ARES / RACES communications in Santa Clara County
- Allows for BBS messaging from stand alone radio stations with no infrastructure requirements
- Simple to use with Outpost program
- Non encrypted data transfer
- Typically uses dedicated links to improve message capacity within a network of stations
- This allows wide area coverage and increased messaging capacity as well as redundancy
- Can be used for keyboard-to-keyboard communication
- Can be used by people who have hearing or speech difficulties.

Satellite Communications

- Satellite dynamics – Geo-synchronous vs LEO - antenna orientation - continuous or periodic contact
- ISS vs LEO type satellites
  - Antenna size / stability
- Antennas for Satellite communications
  - Yagi antenna
  - Arrow antenna
- Circularly Polarized Antennas
  - Pair of perpendicular Yagi antennas
  - Loop antennas
- Predicting pass over events
  - Software can be used to predict potential contact opportunities for your geographic location based on the satellite to be contacted.
  - Typical pass over events last for 2 to 4 minutes depending on a variety of factors.

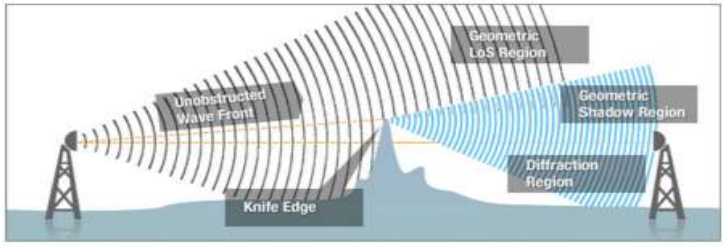
Emergency Communications

- ARES / RACES organizations are local (city / county) level entities that perform ECOM functions in support of local jurisdictions.
- Roles include Field Operator, Net Control Operator, Shadow Operator, Packet Operator (depending on local resources) and training, credentialing for the above roles.
- Participate in Drills - (earthquake, evacuation, power failure, internet shut down), Public service events – (bicycle race, marathon, parade, festivals)
- Primarily using VHF / UHF HT or mobile radios. (Cost effective.)

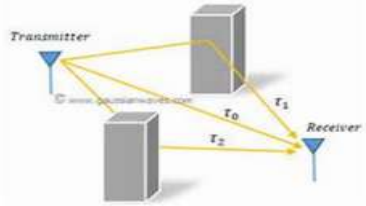
VHF and UHF Propagation

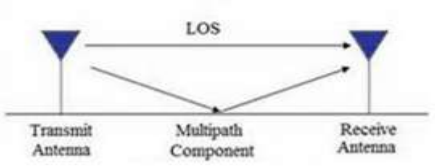
VHF/UHF Propagation Factors

- Primarily line-of-sight
  - The higher the frequency, the more this is true
- Diffraction

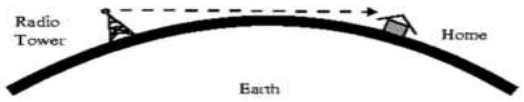


- Multi-path





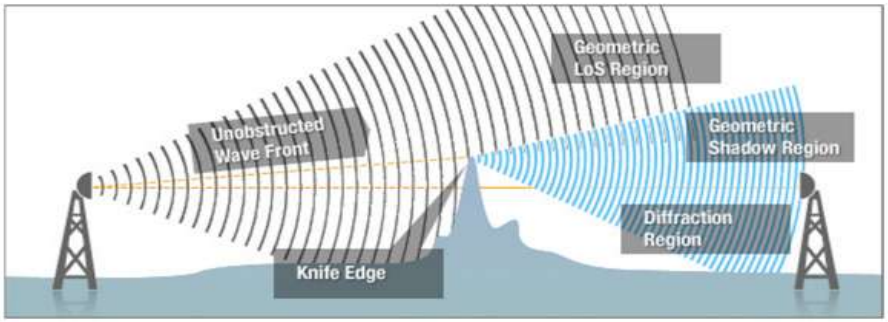
- Curvature of the earth



VHF and UHF Propagation

Diffraction

- Radio waves can diffract (bend) around a sharp object ("knife edge diffraction")

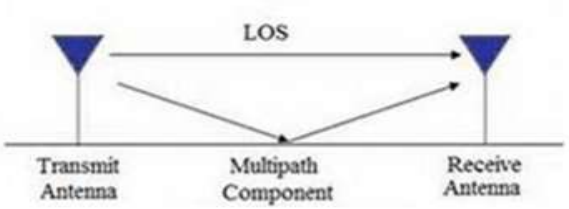


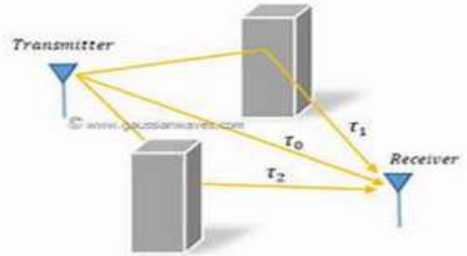
- This can redirect a signal into areas that would not be covered by direct waves (diffraction region)
- But it can distort signals where the diffracted signal collides with the direct signal (geometric shadow region)
- Avoid diffraction as much as possible by raising the antenna as high as possible

VHF and UHF Propagation

Multipath

- Signals may bounce off the ground or surrounding buildings, mountains, etc.



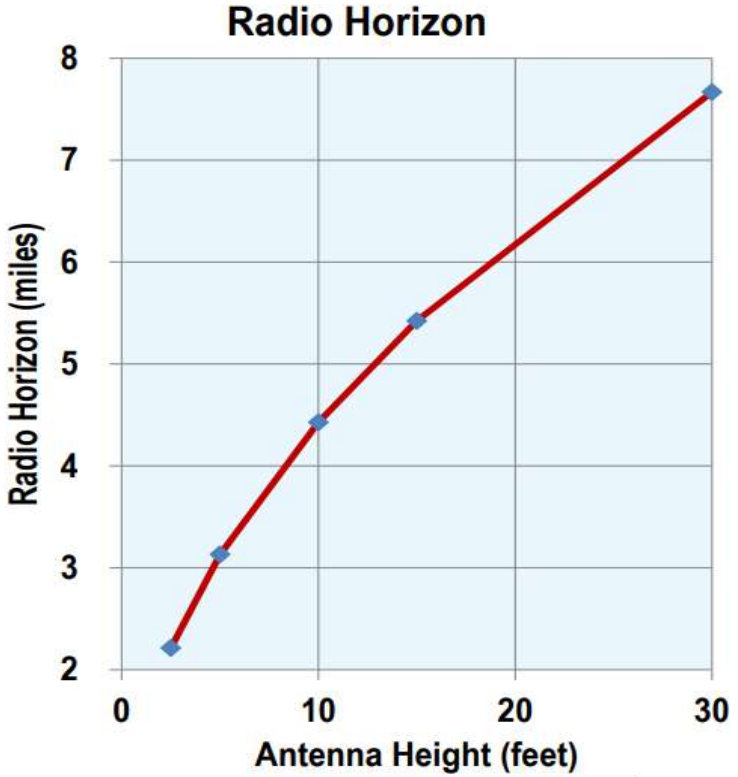


- The reflected copy of the signal will arrive at the receiver with a phase difference which depends on the path length
  - A phase difference of 0 will reinforce the signal
  - A phase difference of 180 degrees will cancel the signal!
  - Other values of phase difference can distort the signal

VHF and UHF Propagation

Radio Horizon at 146 MHz

Height (ft.)	Radio Horizon (miles)	
2.5	2	Table Top
5	3	HT near your mouth
10	4	Tripod with mast
15	5	Small push up mast
30	8	Long push up mast



Does not include the effects of obstacles or terrain

VHF and UHF Propagation

Key Points for VHF/UHF Antennas

- A repeater up on a mountain makes things easier. But it won't always be available for a public service event or an emergency.
- Build your station expecting to use simplex
- Get your antenna up as high as possible
  - Reduces diffraction caused by ground clutter
  - Reduces multipath caused by ground clutter
  - Extends range over curvature of the earth
- A 30 foot push-up fiberglass mast and a roll-up J-pole antenna is highly portable and makes a great antenna for a field station.

HF Communication

- DX hunting - long range – optimizing ground wave, low angle propagation with refraction effects
- NVIS - near range – optimizing high angle propagation, with refraction effects
- CW / USB / LSB / AM
- What works best – not everyone can send / receive CW
- CW is very power efficient – capable of long-range transmission with low power
- Digital modes
- Pactor TNC – allows computer-based communications (very expensive)
- RTTY – Many HF radios support this protocol
- PSK31 – Many HF radios support this protocol
- FT8 – Requires a computer to decode/encode data
- JS8Call – Requires a computer to decode/encode data

HF vs VHF/UHF Propagation

- HF refers to 3MHz to 30MHz frequency bands
- HF bands can have long range but varies with solar events
- Three HF modes of propagation
- Line of sight – fairly consistent, noisy – not preferred mode
- Ground wave – highly conductive ground surface needed, also frequency dependent, lower frequencies work better.
- Sky wave – Refraction from ionized particles.
- Two VHF/UHF modes of propagation
- Line of sight – reliable for short range communications
- Skywave / Tropospheric Ducting – not reliable

Ionization layers (HF Propagation)

- Molecules in the atmosphere can develop free electrons when subjected to UV or Solar radiation – this free electron layer is conductive and can refract radio signals.
  - HF refraction layers - depends on electron density in layer
    - D Layer – 60km to 100km – absorbs lower frequency radio signals, active during the day
    - E Layer – 100km to 125km – thin dense layer mainly refracts VHF signals, active during the day
    - F1 Layer – 200km to 275km – short range HF propagation active during the day,
    - F2 Layer – 200km to 275km –active all day and night, mainly contributes to HF refraction

Refraction properties

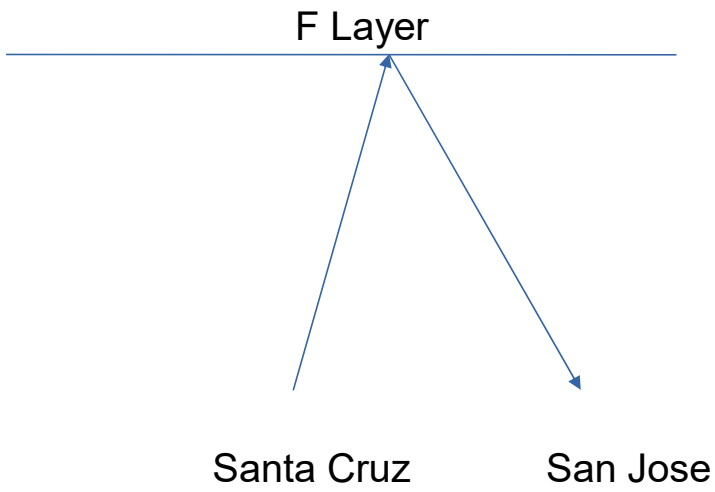
- Refraction depends on the frequency of radio transmission, the density of free electrons (ionization) in the layer and incident angle.
  - The maximum usable frequency (MUF) is the frequency at which refraction is no longer possible.
  - The lowest usable frequency (LUF) is affected by D layer absorption or attenuation.
  - Sunspot number predicts the level of ionization, higher number implies higher MUF
  - Solar Flux Index (SFI) measures the level of ionization; typical range is 70 to 100+ ; higher counts give higher MUF
  - Geomagnetic indices measures the impact of solar particles on the earth's magnetic field. These events can either decrease or increase the MUF or increase the LUF
    - A index and K index measure magnetic storm intensity, low number give stable conditions. Typical A index ranges between 0 to 400, typical K index ranges between 0 to 9.
  - All of these can be used to estimate if a frequency can be used for HF communication effectively.

Sky Wave Propagation

- Incident angle is the angle of the incoming signal relative to the ionospheric layer.
  - Radio signals with lower incident angles propagate farther than radio signals with higher incident angles but can also affect refraction.
    - This results in the phenomena of skip zones where there are alternating zones surrounding a point of transmission where transmission is possible and then transmission is not possible with low incident angle antennas.

NVIS Sky Wave Propagation

- Radiation angle is typically 75° or greater. Useful for short to medium range communication where line of sight or low angle sky wave transmission is not possible.



NVIS Sky Wave Propagation

- Short line of sight between transmitter and F2 layer, short line of sight between receiver and F2 layer.
- Minimal path length through D layer reduces attenuation.
- Site terrain does not affect propagation.
- Low power operation is possible as losses are reduced.
- Antenna orientation is not relevant, just need steep angle of radiation. This allows substantial flexibility in antenna setup. – This ease of use is a major benefit for this type of radio communication for ARES / RACES organizations when regional communications is needed.

NVIS Sky Wave Propagation

- Loop antennas are optimal for mobile operation
- Whip antennas bent horizontal work in mobile operation with reduced sensitivity.
- Turnstile inverted V antennas are optimal for fixed operation but remember to limit mast height with ends of dipole near ground level.
- Inverted L antenna’s can be used as well with good results.
- Traditional dipoles also work well when placed slightly above steel (conducting) roofing materials.

Fan Dipole HF antenna configurations

- If the antenna location is sufficiently big enough, a wire fan dipole type of antenna can provide an efficient antenna system that optimizes long range performance over multiple HF bands (no tuner required.) This is also dependent on antenna height. This allows lower transmitter power to be used to create effective communications while being not obvious to people near by.
- Yagi / Rhombic are even better but are huge and only single band.
- Windows based antenna analysis program that allows you to change the antenna design and observe the effects of the change in design. Can be used to try and optimize your HF antenna configuration in “challenging locations.”
- https://www.qsl.net/4nec2/

Portable HF antenna configurations

- Ease of deployment for portable antennas is highly desired to mitigate set up issues. Spider antennas can offer portable multiband resonant (efficient) antennas that can be set up with multiple people.
- End fed half wave wire dipole antennas offer an easy to set up (one person) solution for single band operation that gives good performance.
- Vertical antennas are even easier to set up but are susceptible to high noise from near by noise sources.
- Vertical antennas are the only practical long-range antenna to use in a mobile application but are even more challenged by limited size (reduced efficiency) and adjacent noise sources.

Planning

- Any activity that you expect to be a success requires planning.
- With any event, having to work to achieve a prize is a draw.
- Is this a stand-alone event or part of a scheduled event?
- Examples of scheduled events include “Field Day”, “Parks on the Air”, “Fourth of July”, “Fox Hunt”, “Geocaching”, “Parades”, “Bicycle Runs”
- Participants can be invited prior to the event or public events can be used to draw in those that are intrigued to participate.
- Social Media can be used as a meeting place to get interested people to interact and create a community of participants.
- What will you do for the event?