



CHEROKEE AMATEUR RADIO SOCIETY

Introduction to VHF and UHF

Applications to the Amateur Radio uses of this spectrum

What you will learn

- What is considered to be VHF and UHF and why?
- How does it differ from HF bands in uses and characteristics?
- What parts of the spectrum can amateurs use?
- What types of modulation are used? Why dominated by FM?
- Can I use AM or SSB on VHF and UHF?
- What antennas do I need? What about polarization?
- How are digital modes used on VHF and UHF?
- What is the range of acceptable communications with VHF and UHF signals?
- How does a repeater work?

UNITED STATES FREQUENCY ALLOCATIONS THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

■ AERONAUTICAL MOBILE	■ INTER-SATELLITE	■ RADIO ASTRONOMY
■ AERONAUTICAL MOBILE SATELLITE	■ LAND MOBILE	■ RADIO DETERMINATION SATELLITE
■ AERONAUTICAL RADIONAVIGATION	■ LAND MOBILE SATELLITE	■ RADIONAVIGATION
■ AMATEUR	■ MARITIME MOBILE	■ RADIONAVIGATION SATELLITE
■ AMATEUR SATELLITE	■ MARITIME MOBILE SATELLITE	■ RADIONAVIGATION
■ BROADCASTING	■ MARITIME RADIONAVIGATION	■ RADIONAVIGATION SATELLITE
■ BROADCASTING SATELLITE	■ METEOROLOGICAL	■ SPACE OPERATIONS
■ EARTH EXPLORATION SATELLITE	■ METEOROLOGICAL SATELLITE	■ SPACE RESEARCH
■ FIXED	■ MOBILE	■ STANDARD FREQUENCY AND TIME SIGNAL
■ FIXED-SATELLITE	■ MOBILE SATELLITE	■ STANDARD FREQUENCY AND TIME SIGNAL SATELLITE

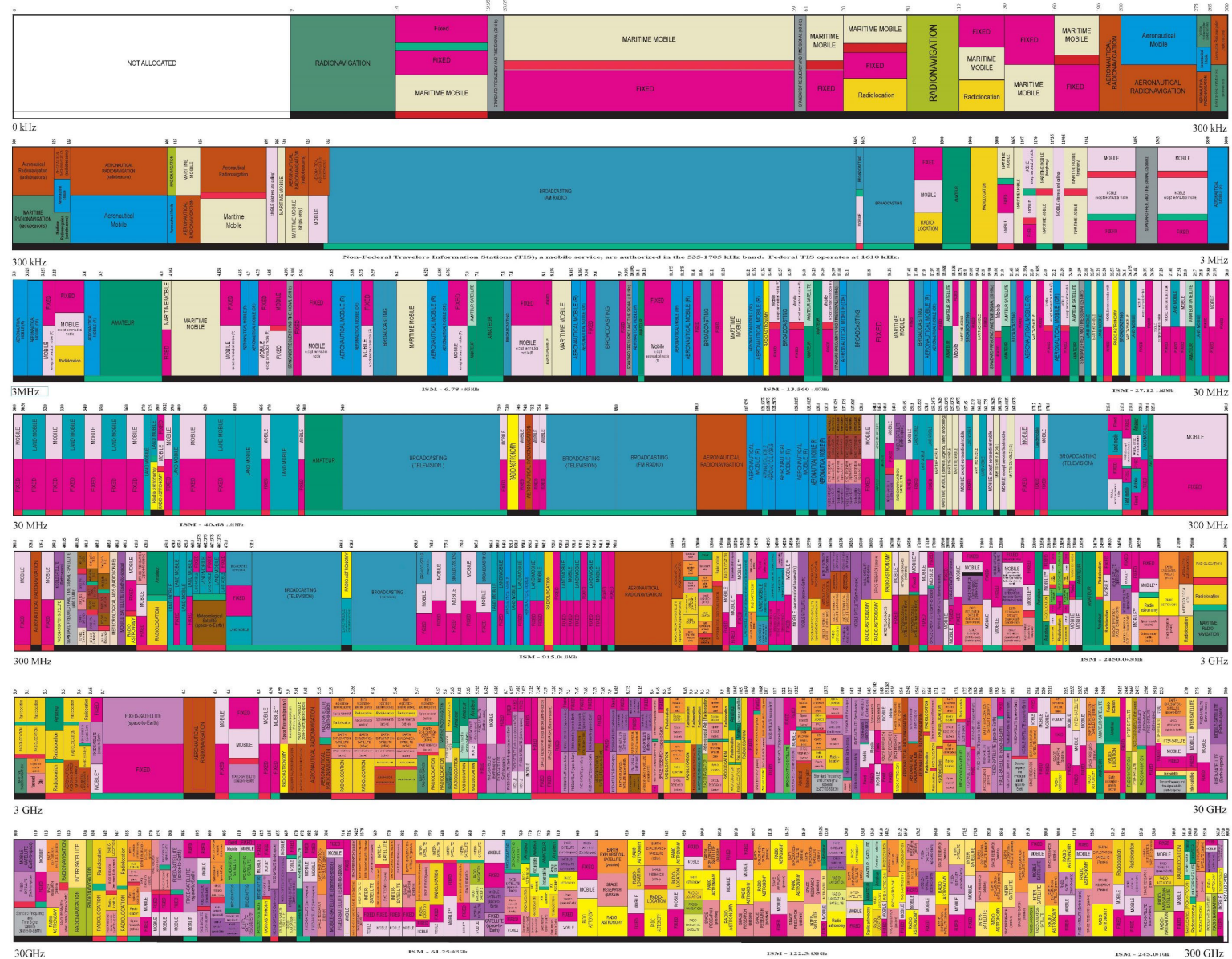
ACTIVITY CODE

■ FEDERAL EXCLUSIVE	■ FEDERAL/NON-FEDERAL SHARED
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ALLOCATION USAGE DESIGNATION

SERVICE	EXAMPLE	DESCRIPTION
Primary	FIXED	Capital Letter
Secondary	Mobile	1st Capital with lower case letters

The chart is a public release as a part of the "Table of Frequency Allocations" made by the FCC and NIST. It is not an official FCC or NIST document. It is for informational purposes only. The table of frequency allocations is subject to change. Therefore, for complete information, users should consult the table of frequency allocations.



LF

HF

HF

VHF

UHF

Microwave

SHF

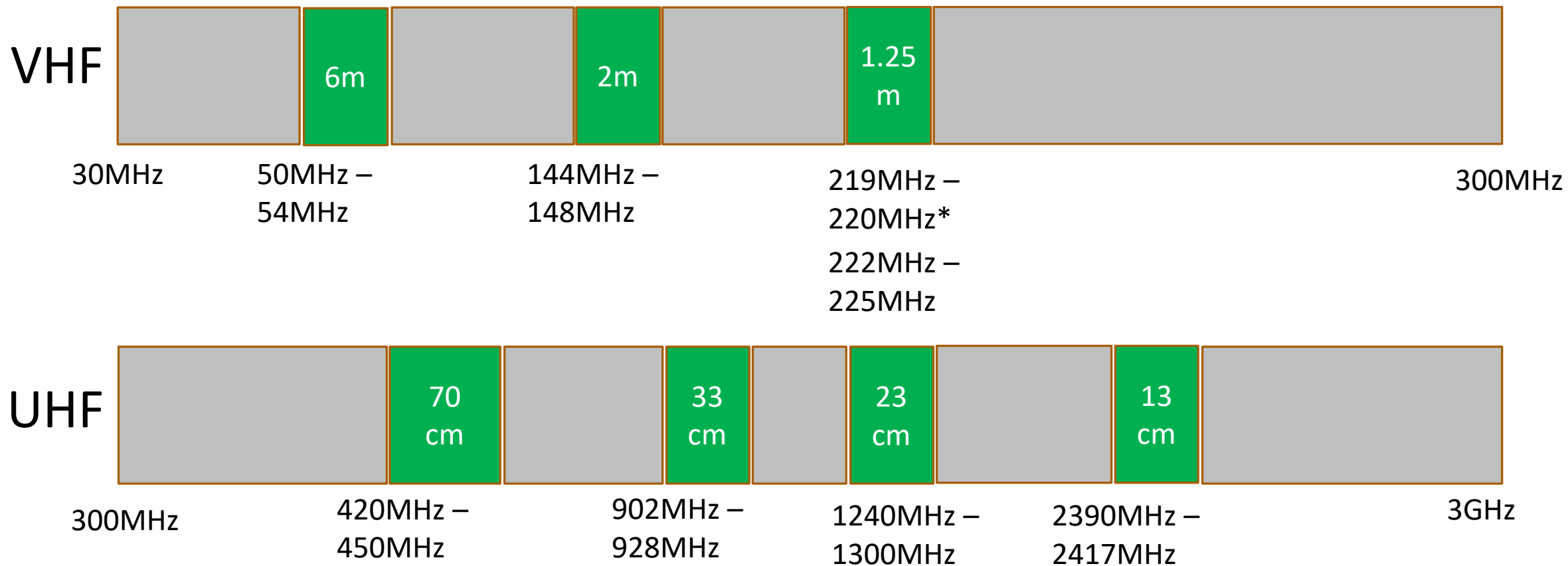
EHF

U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management
JANUARY 2016



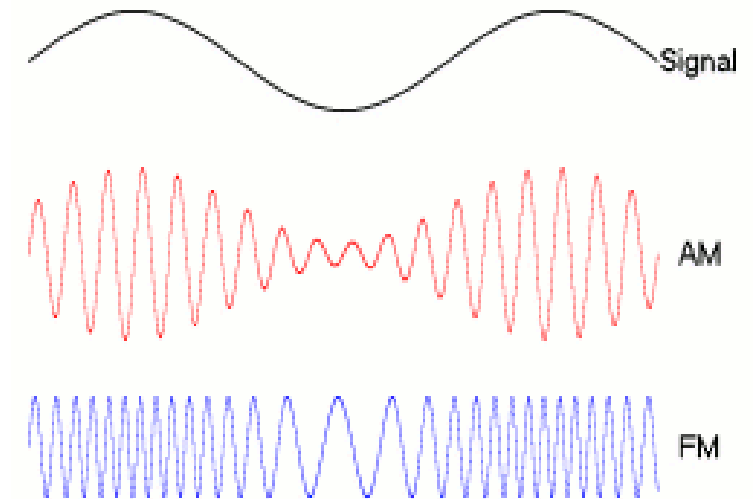
PLEASE NOTE: THE DATA ALLOCATED HEREIN IS ONLY THE SERVICE DESIGNATION. IT DOES NOT INDICATE THE FREQUENCY BANDS OR THE BANDWIDTHS OF THE SERVICES. THE BANDWIDTHS OF THE SERVICES ARE LISTED IN THE FREQUENCY ALLOCATIONS TABLE.

Amateur Radio VHF and UHF Spectrum



Modulation Used

- FM (frequency modulation) is the most common.
- AM is used on VHF for Aircraft communications
- CW can be used at any of the VHF or UHF frequencies, but is most often used by the Microwave amateurs
- SSB is used for VHF and UHF Contesting and is almost always horizontal polarization
- Digital modes are common. FT8, FLDIGI, and VARA-FM for Winlink, are most common. FM-packet still used but fading.
- Digital voice mode is used for D-Star, Fusion, AllStar, DMR, and new modes like M17



What Modes I can use with what radio?

- Any of the discussed modes can be used, but require a radio equipped for these modes.
- Check your equipment for what is supported.

AM/FM/SSB/CW/D-Star



VHF/UHF/DMR



VHF/UHF/FM & DMR



AM/FM/SSB/CW/Fusion



VHF/UHF/Fusion

VHF/UHF Antennas



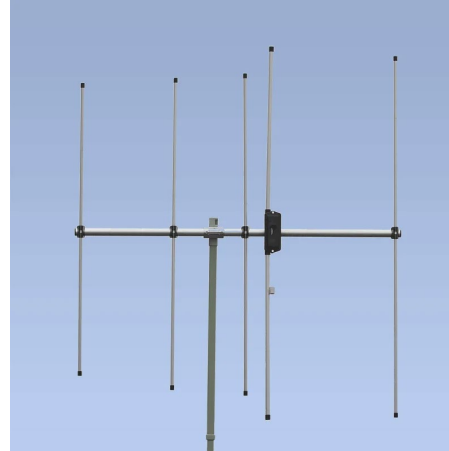
Whip
0-3dB



J-Pole
3-4dB



Vertical
4-5dB



Yagi
10-20dB

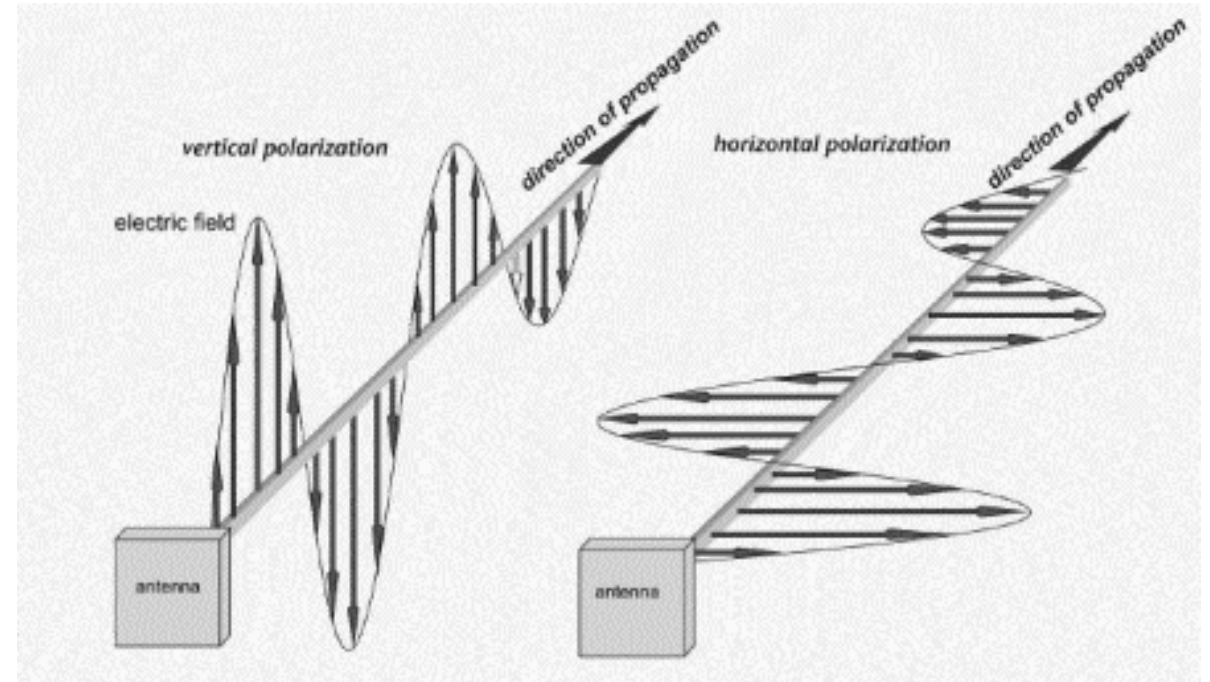


High Gain Yagi
>20dB

What differentiates them?
One word : GAIN

Polarization

- **Polarization matters**
- dB losses are huge for off-axis polarization
- By convention FM VHF/UHF is vertical polarization.
 - Digital modes like VARA are FM and vertical
 - Influence of this is mobile communications
- By convention SSB, CW, and some digital modes like FT8 are horizontal polarization.
- Typically these are Yagi antennas at these frequencies.

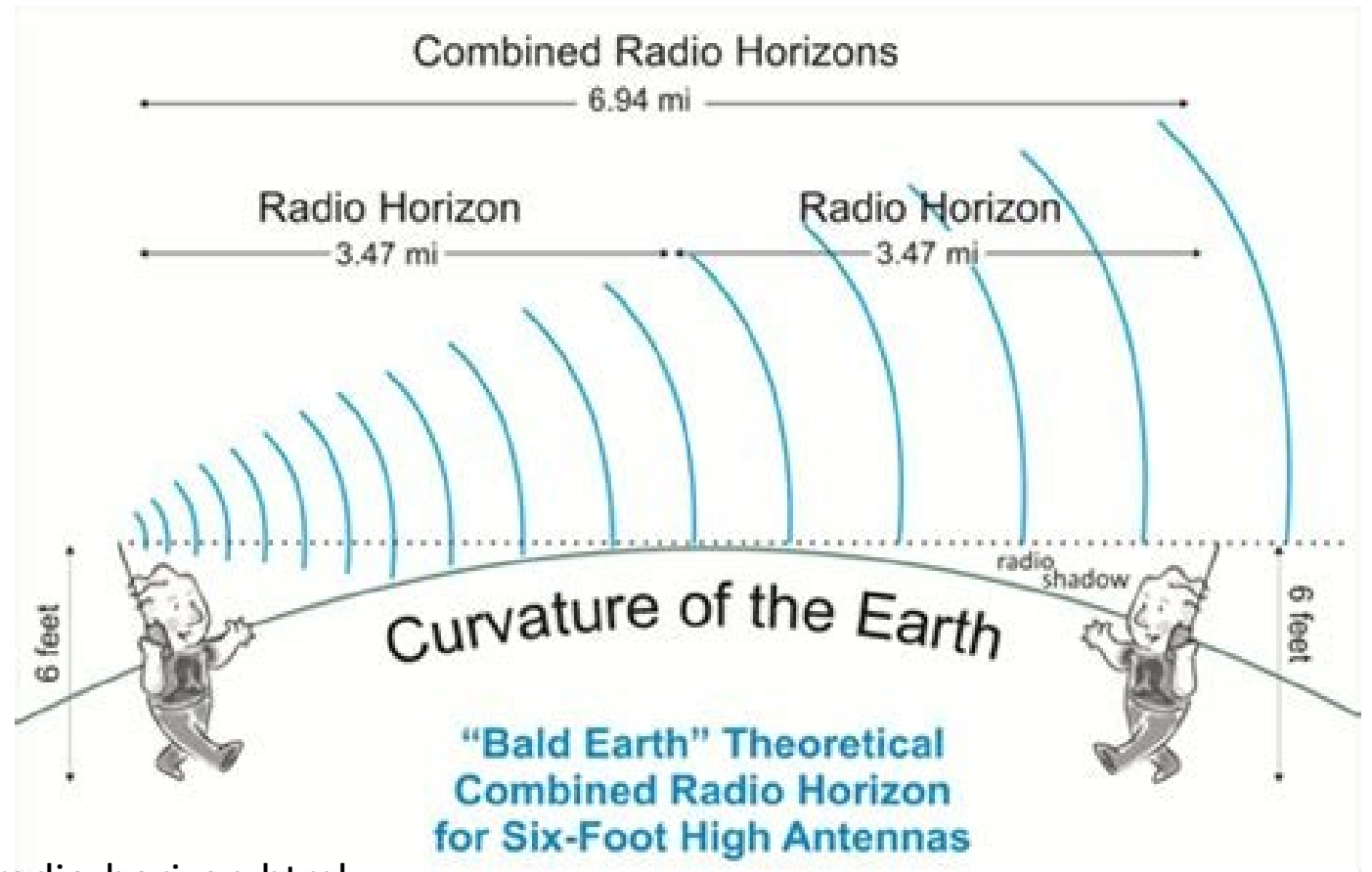


Radio Horizon

$D = 1.42 \sqrt{h}$ where h is the antenna height

This is further than the optical horizon.

- Height makes a huge difference. (*Thus why KG4VUB is on top of a mountain*)
- The radio shadow is where a signal is blocked by an obstruction. This could be the curve of the earth, buildings, etc.
- Pine log is 2,338 feet
 - $D = 1.42 \sqrt{2338} = 69 \text{ miles}$ possible range



Power, Mode, Height all matter

TABLE 1. FM Range In Miles @ 99% Reliability

TABLE 1. FM Range In Miles @ 99% Reliability								
	Antenna Gain and Height							
Antenna Gain	3 dB		6 dB		9 dB		12 dB	
Configuration	30'	60'	30'	60'	30'	60'	30'	60'
5W, No Preamp	28	42	38	52	48	63	59	75
25W, No Preamp	40	53	50	65	60	77	72	96
80W With Preamp	53	68	65	82	77	110	96	230*
160W With Preamp	59	75	70	93	87	175	130	260

* Or what happens when you're located right at the edge of the range.

TABLE 3. SSB Range In Miles @ 99% Reliability

TABLE 3. SSB Range In Miles @ 99% Reliability								
	Antenna Gain and Height							
Antenna Gain	6 dB		9 dB		12 dB		15 dB	
Configuration	30'	60'	30'	60'	30'	60'	30'	60'
25W, No Preamp	63	80	75	100	93	215	175	272
80W With Preamp	80	130	100	245	215	280	272	310
160W With Preamp	90	200	160	268	252	295	285	325

What about VHF or UHF Propagation?

- At frequencies above 50 MHz there is very little ionospheric reflection. Signals travel right through the ionosphere and into outer space.
- Tropospheric conditions can “duct” signals beyond the radio horizon. EsNA (Sporadic E) conditions are reported on many space weather sites.
- MUF (Maximum Usable Frequency) tells us what is practical.

Solar-Terrestrial Data
27 Jan 2022 1933 GMT
SFI 102 SN 71
A 10 K 2
X-Ray B2.5
304A 137.8 @ EVE
PF 76 Ef 1310
Aurora 1/n=1.99
Bz -2.9 SW 450.5

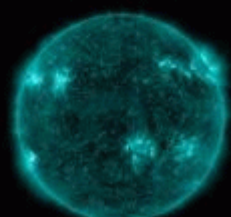
HF Conditions		
Band	Day	Night
80n-40n	Fair	Good
30n-20n	Good	Good
17n-15n	Fair	Fair
12n-10n	Poor	Poor

VHF Conditions
Aur Lat 67.5°
Aurora Band Closed
6m EsEU Band Closed
4m EsEU Band Closed
2m EsEU Band Closed
2m EsNA Band Closed
EME Deg Good
Solar Flare Prb 48%

MUF
MS 0 6 12 18 UTC MAX
MIN

Geonag Field QUIET
Sig Noise Lvl S1-S2
MUF US Boulder 22.83

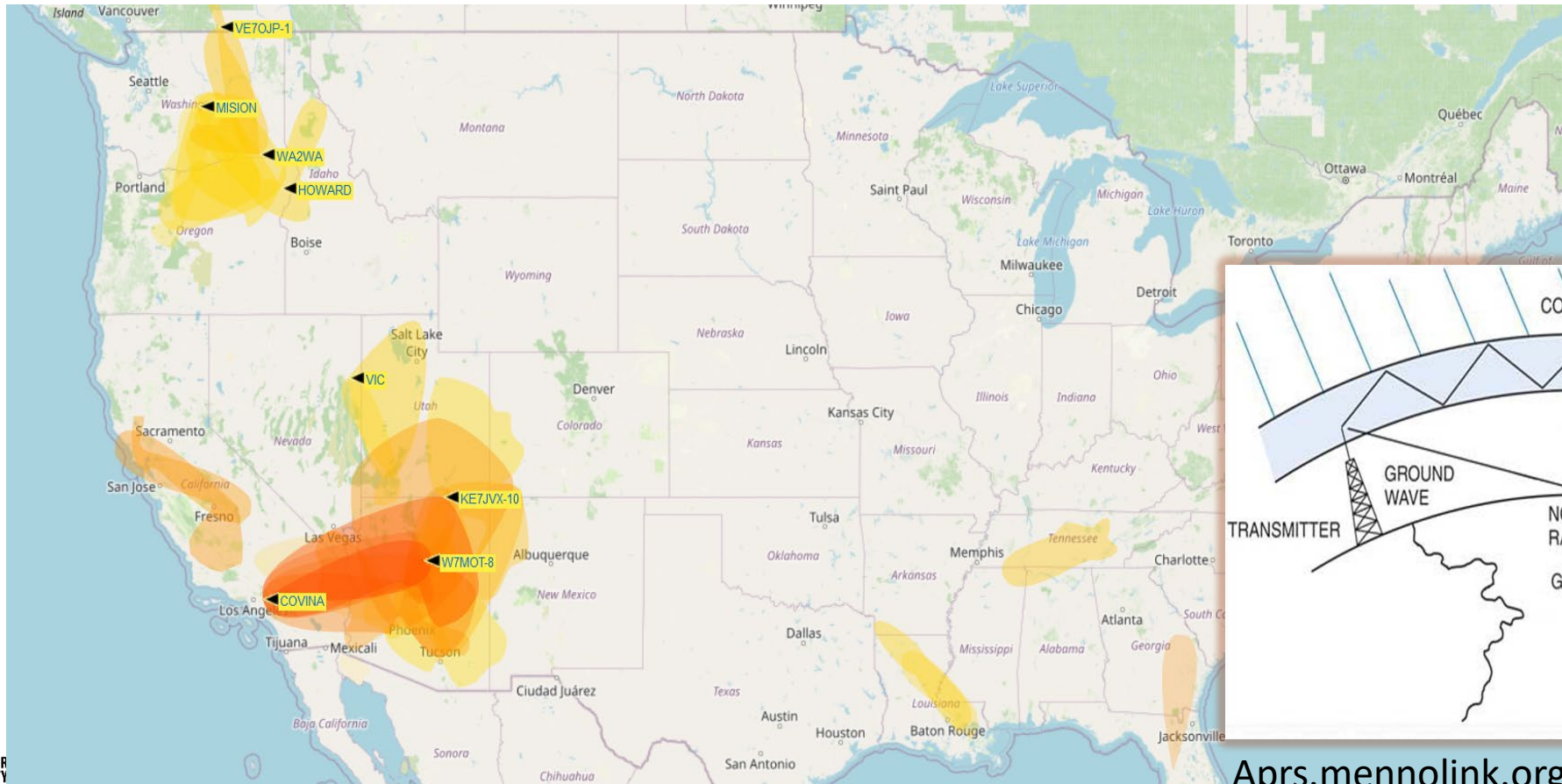
Current Solar Image



<http://www.n0nbh.com>
Copyright Paul L Herrman 2021

VHF Propagation Map

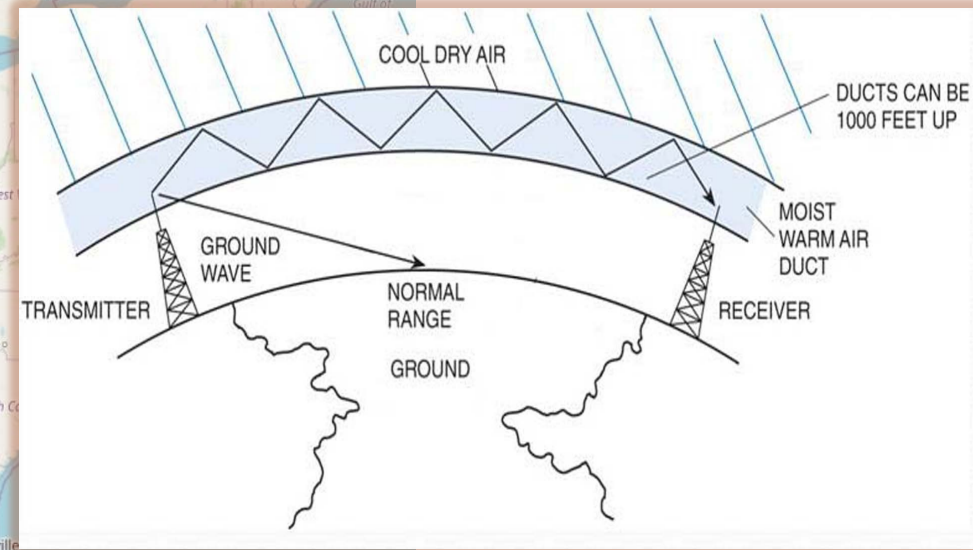
Predictions for Tropospheric ducting propagation



Other Sources

Dxmaps.com

Dxinfocentre.com/tropo

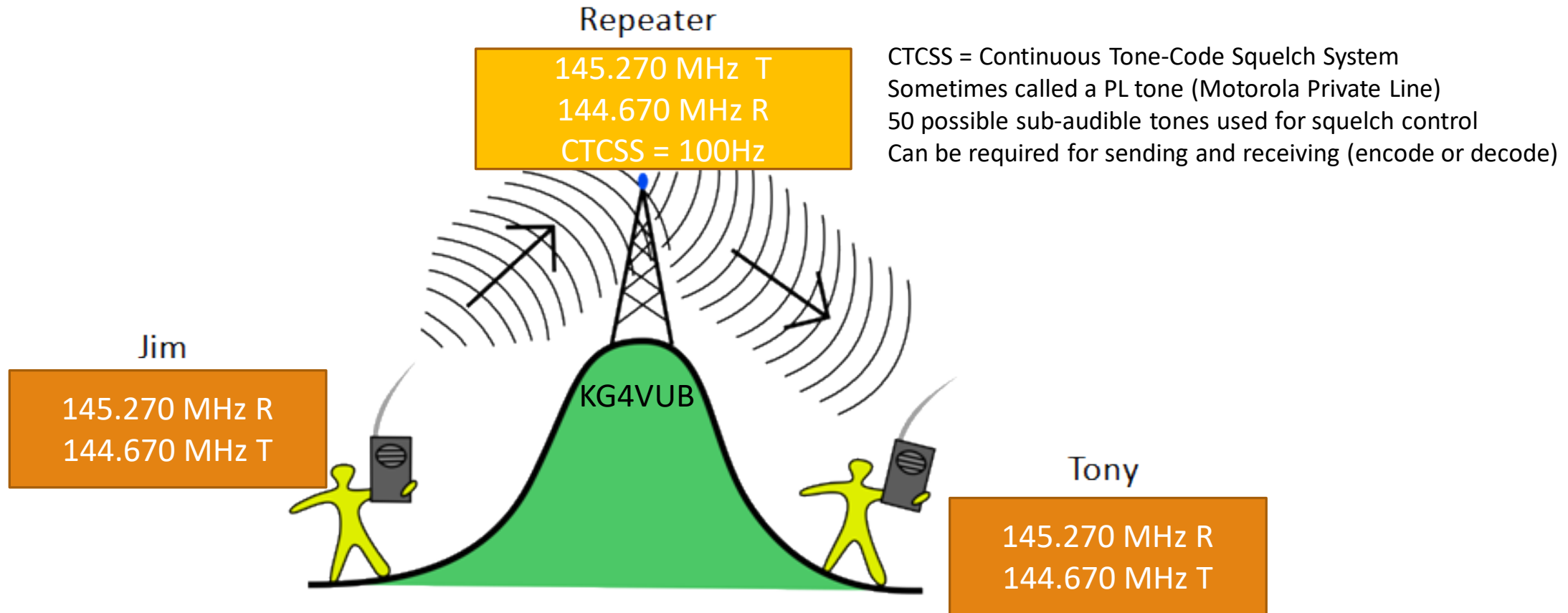


Aprs.mennolink.org

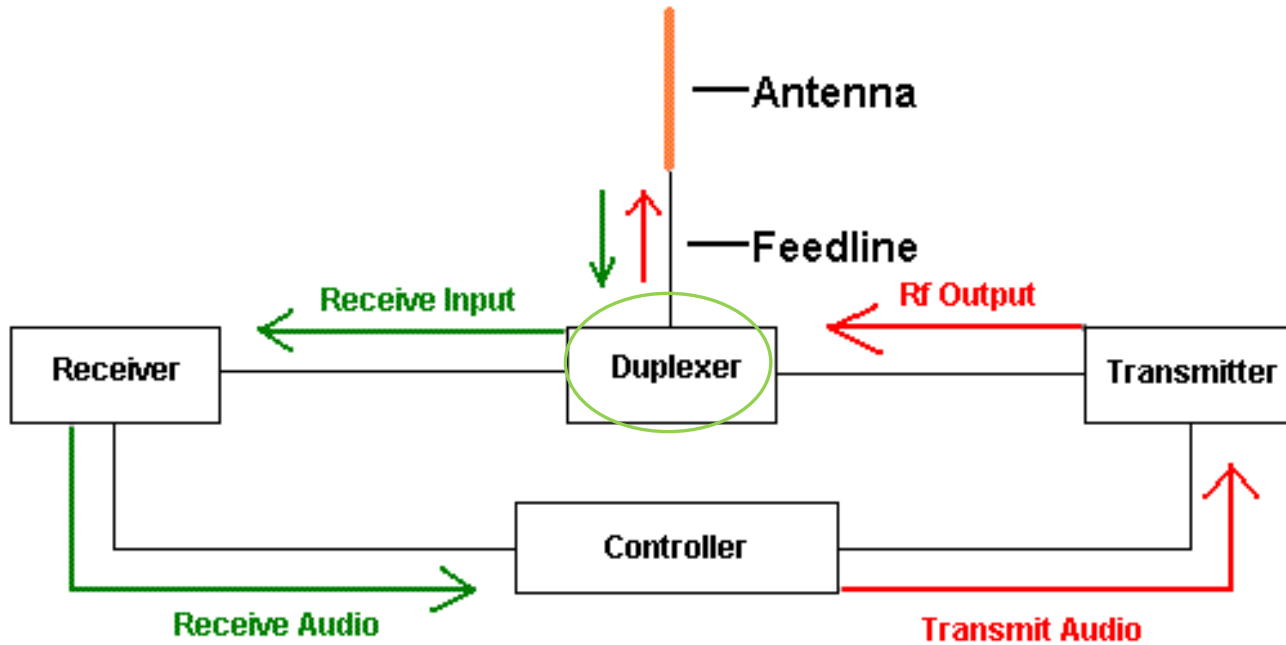


How do Repeaters Work?

Basic Repeater

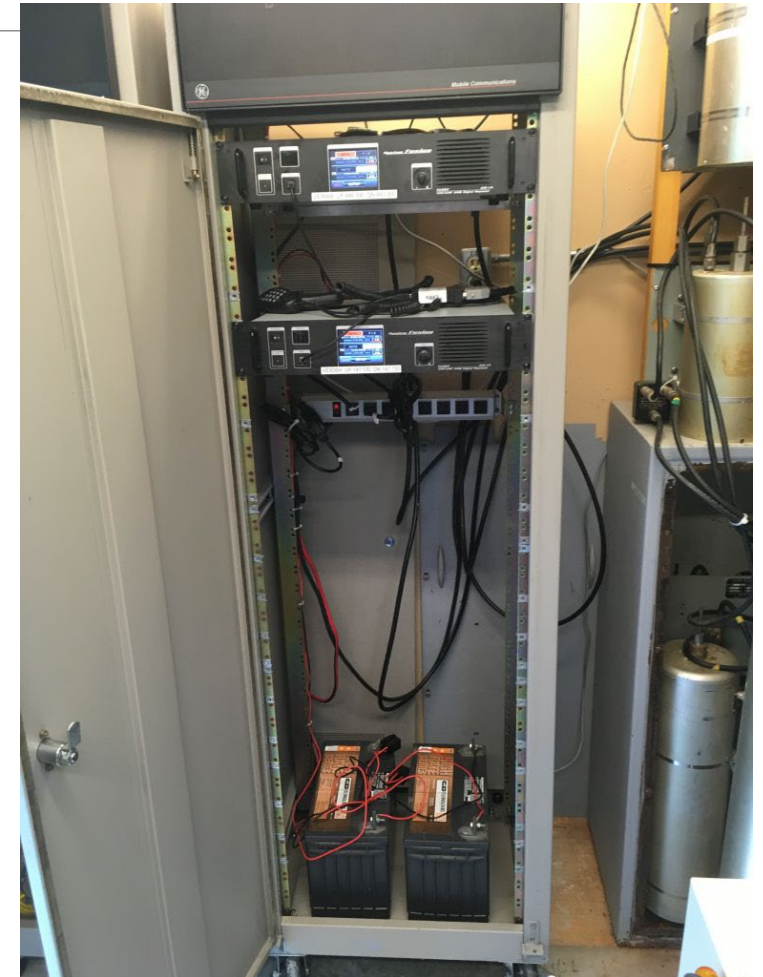


Components of the Repeater



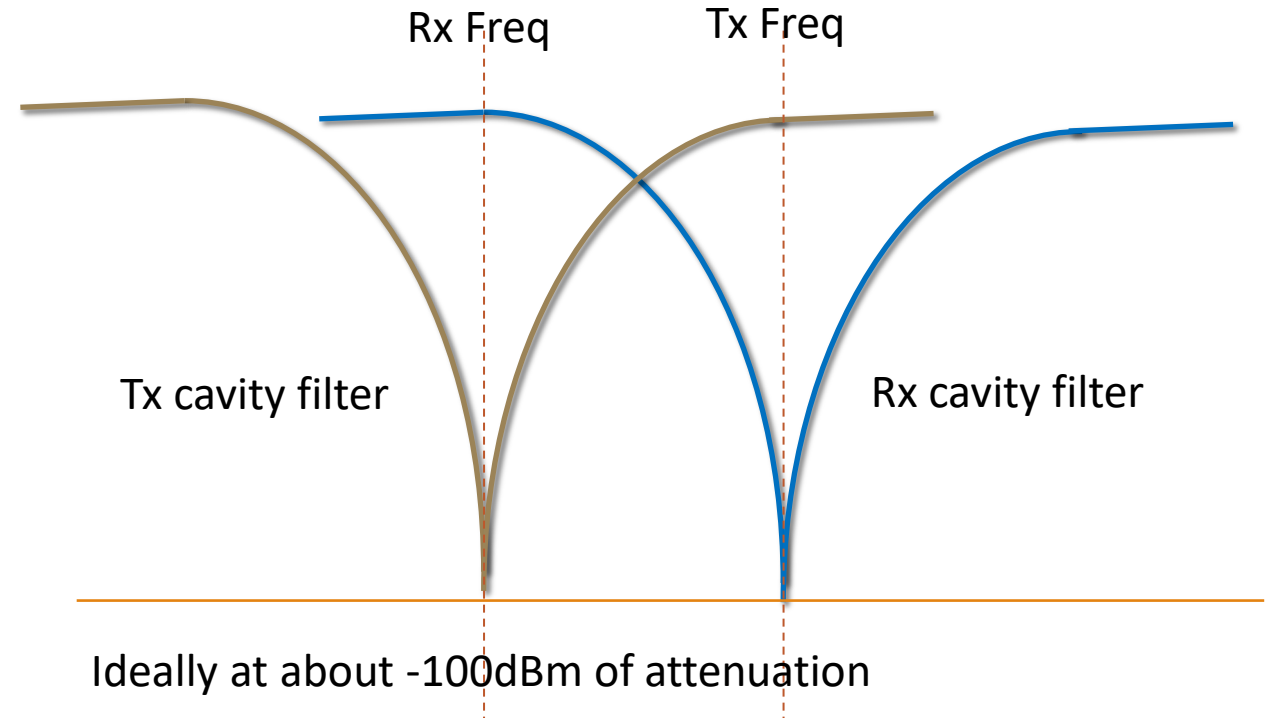
BASIC REPEATER BLOCK DIAGRAM

N4UJW



Duplexer makes it all work

- Basically a deep notch filter for protecting the receiver from the transmitter's output frequency
- Separate Transmit and Receive antenna do not solve the problem. The receiver would be desensitized in the close proximity of the transmitted signal.
- Receive filter notches out the transmitter frequency
- Transmitter filter notches out the receiver frequency





CARS Club

ARES and RACES uses for VHF and UHF

How we apply this information in practice?

What uses does the club have for VHF/UHF

How is it used for ARES and public service?

Mark Schulze –KO4IFY will explain how we use VHF and UHF for club activity



ARES/RACES





ARES/RACES



A General Overview



ARES/RACES



Acronyms, acronyms, acronyms

A mateur

R adio

E mergency

S ervices

R adio

A mateur

C ivil

E mergency

S ervice



ARES/RACES



- What is ARES?
- What is RACES?
- What is the difference?
- Who makes up ARES/RACES?
- What ARES/RACES does?
- What ARES/RACES DO NOT do?
- What training is required, where is it obtained and how much does it cost?
- What equipment is needed and what's the cost?
- How to register?



ARES/RACES



➤ What is ARES?

- (ARES) is a volunteer group organized through the American Radio Relay League (ARRL). You do not need to be a member of the ARRL to be part of ARES. The only requirements are to possess an Amateur Radio licensee and have a desire to serve. ARES members enjoy no special privileges and must comply with all FCC and other government rules when operating. If the President chooses to limit access to the Radio Spectrum under the War Powers Act, or another emergency declaration, ARES members must fully comply with these rules.



ARES/RACES



➤ What is RACES?

- If the President chooses to limit access to the Radio Spectrum under the War Powers Act, or another emergency declaration, ARES members must fully comply with these rules.
- (RACES) was created to deal with just this situation. Amateur Radio Operators must register with the state or local government in advance of an emergency to be part of RACES. There are many special regulations in part 97 of the FCC rules dealing with this service (§97.407). Other than limited drills, RACES can only operate during an officially declared emergency.



ARES/RACES



-
- What is the difference?
 - The functions are basically the same. A presidential declaration may cause ARES operations to cease and a declaration COULD be made to activate RACES.
 - Many amateur operators are registered with both organizations so that they can just “change hats” to meet the requirements of any given situation.



ARES/RACES



- Who makes up ARES/RACES?
 - Fellow Amateur Radio Operators just like you!





ARES/RACES



- What ARES/RACES members do?
 - ARES/RACES members are a well trained, disciplined group of amateur radio operators that follow the chain of command and endeavor to support the served agency.
 - ARES/RACES members deploy ONLY when requested by our served agency, and only when approved by the Emergency Coordinator of Cherokee County, or one of the delegated Assistant Emergency Coordinators



ARES/RACES



The Mission

Cherokee County ARES supports our primary served agency, Cherokee County EMA- Emergency Management Agency, and when requested, other agencies in our area or NW GA District.

- Cherokee County ARES supports the following activities:
 - Field Day along with our Club-WX4CAR.ORG
 - The Georgia Death Race
 - The Georgia Jewel
 - NW GA District ARES
 - The Annual ARRL Simulated Emergency Test (SET)
 - As needed, Skywarn Weather NETS



ARES/RACES



-
- What ARES/RACES members DO NOT do?
 - ARES/RACES members are NOT storm-chasers, nor are they First-Responders.
 - ARES/RACES members DO NOT self-deploy.



ARES/RACES



➤ Training

- What training is required?
- Where is it obtained?
- How much does it cost?



ARES/RACES



- What training is required?
 - The primary training requirements are defined in your personal “ARES Task Book”.
 - The “ARES Task Book” can be downloaded at no charge from the [Cherokee-ARES.ORG Website](http://Cherokee-ARES.ORG)



ARES/RACES



- Where is the training obtained?
 - Training consists primarily of on-line self study courses.
 - ICS Courses are conducted by FEMA.
 - [FEMA Catalog](#)
 - Additional developmental courses are conducted by the ARRL.
 - [ARRL Catalog](#)



ARES/RACES



-
- How much does the training cost?
 - NOTHING
 - NADA
 - IT IS FREE



ARES/RACES



-
- What equipment is needed and what's the cost?
 - You can start with a minimal investment and grow as your knowledge, license privileges and desires (and budget) expands.



ARES/RACES



- An in-expensive HT to start on VHF/UHF
- Add a mag mount antenna.
- Approximately \$65 can get you on the air mobile.



Baofeng GT-5R 5W Dual Band Radio [Upgraded Legal Version of UV-5R]

★★★★☆ 50 reviews
\$26.99



Dualband Magnetic Mount Antenna
★★★★☆
\$21.99
prime

- Or more and **more** and **more** for as much as you want to spend. The hobby with an infinite price cap.



ARES/RACES



- How does one register?
- Go to: <http://www.cherokee-ares.org/registration.html>
- Complete the Cherokee ARES/RACES Orientation
- Download and complete the:
 - Cherokee ARES/RACES Orientation Quiz
 - Cherokee ARES FSD-98 Registration Form
 - Cherokee RACES Registration Form
 - Send the completed quiz and forms to:
Cherokee.ga.ares@gmail.com



ARES/RACES Summary

- What is ARES?
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Questions or Comments:





Thank you

Special thanks to all those that unknowingly provided the material for this presentation.