Radio Merit Badge

Information to help you meet the requirements.

By Tom Schuessler, N5HYP

Amateur Radio and the Radio Merit Badge

- Amateur Radio can be a great introduction to a career in electronics, sciences like meteorology, emergency services and broadcasting.
- Provides a basis for a lifetime of learning and a springboard for lasting relationships amongst like minded individuals.
- Many opportunities for public service.

Radio Merit Badge Requirements

- 1. Explain what radio is. Discuss the following:
  - a. The differences between broadcast radio and hobby radio.
  - b. The differences between broadcasting and two-way communications.
  - c. Radio call signs and how they are used in broadcast radio and amateur radio
  - d. The phonetic alphabet and how it is used to communicate clearly.

What is Amateur Radio?

- Amateur Radio is a licensed radio service designed for personal, non-business communication. (Hobby Radio)
- Broadcast Radio/TV is a licensed one-way service (One to many).
- *Part 97.3 (4) Amateur service. A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.*

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- **Can't make money with it.**

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- Family Radio Service (FRS), is an example of an unlicensed hobby radio service.

What is Broadcasting

- **Broadcasting** is a method of transmitting radio, Internet or television signals (programs) to a number of recipients ("listeners" or "viewers") that belong to a large group. This group may be the public in general or a relatively large audience within the public in general.

Wikipedia

Broadcast vs. Amateur Radio

- Broadcasting – One way transmissions intended for the reception of many.
- Amateur Radio – Two way communications where both parties use radio transmissions to convey information.
- *(Note; Amateur Radio communications are not limited to only two persons, but usually only one of them can communicates at a given time).*

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Call Signs

- All radio services are assigned call signs by their governing bodies. In U.S. the governing body is the **FCC**, **Federal Communications Commission.**
- Canada has the **CTRC, Canadian Radio-Television and Telecommunications Commission.**
- Internationally, call sign prefixes are designated by the **ITU, International Telecommunications Union.**

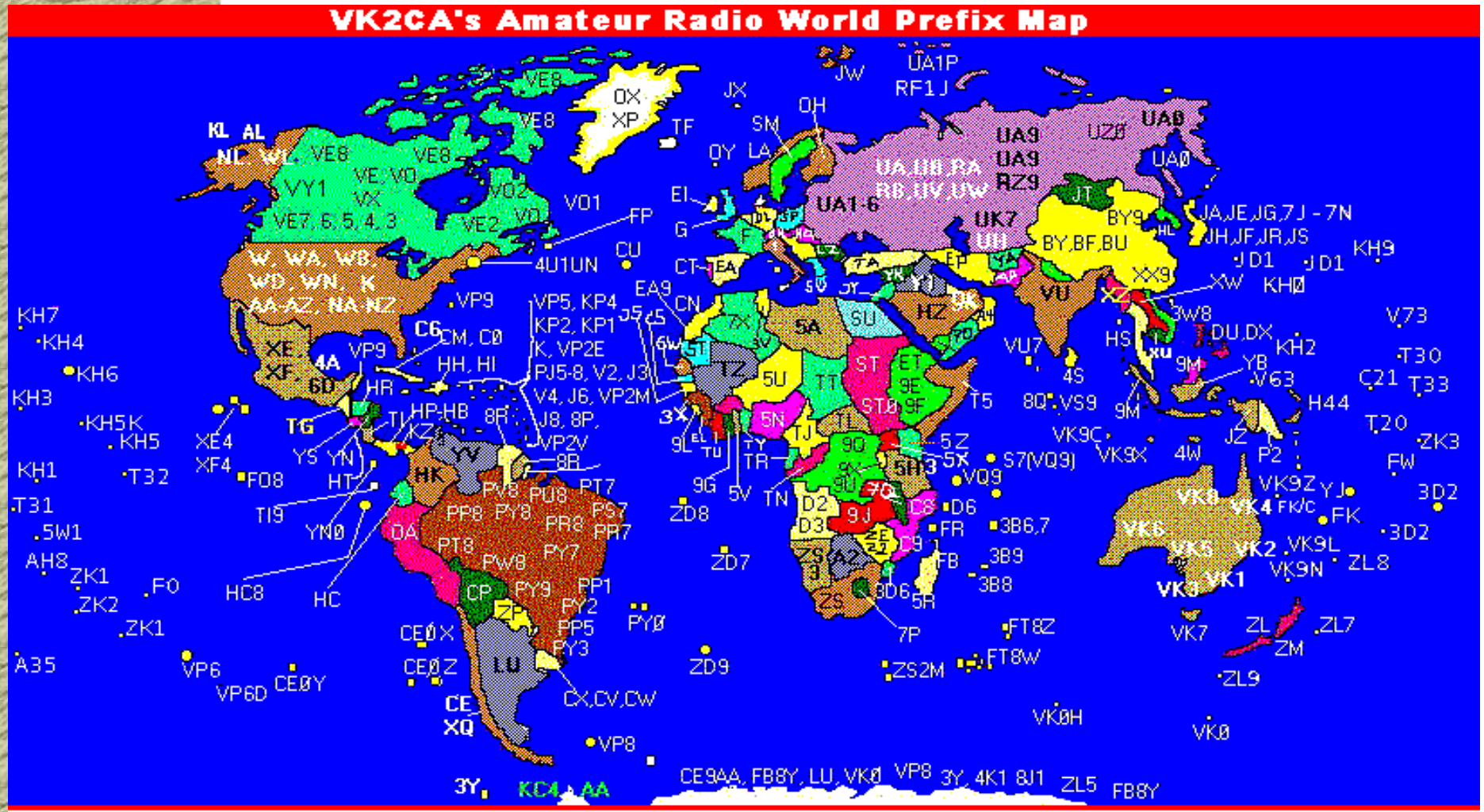
North America Broadcast Call Signs.

- Call signs for broadcast stations in the US always start with a K or W. K being west of the Mississippi and W East. Following that 2 or 3 additional letters.
- Exceptions such as WFAA in Dallas and KDKA in Pittsburgh.
- Canadian stations have call sign starting with CF-CK and CY-CZ with 2 more characters.
- Mexican stations start with X.

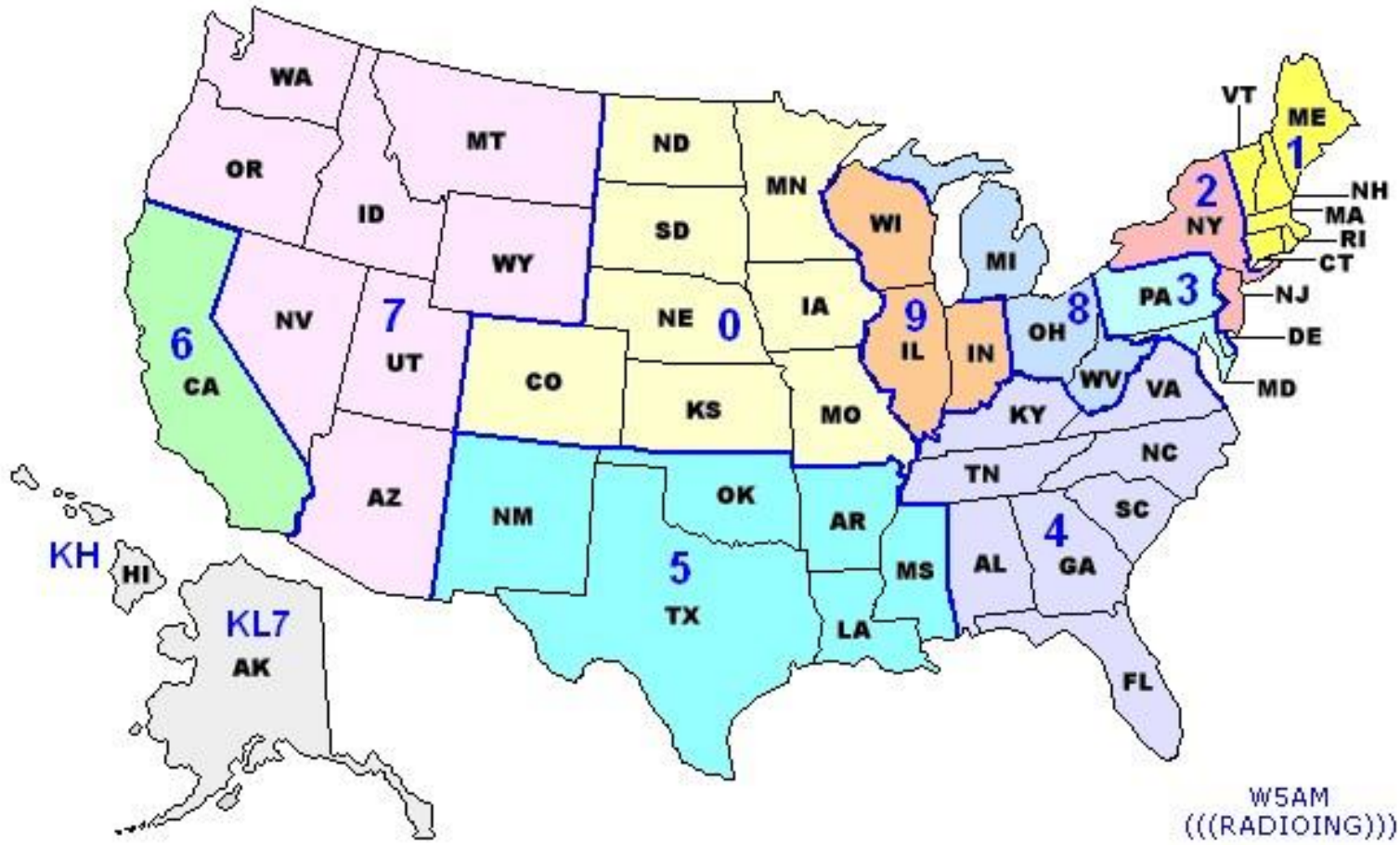
Examples of Call Sign Prefixes

- Australia uses *AX*, *VH–VN*, *VK* and *VZ*.
- Canada uses *CF-CK*, *CY-CZ*, *VA-VG*, *VE*, *VO*, *VX-VY*, and *XJ-XO*.
- Germany uses *DA-DR*
- India uses *AT–AW*, *VT–VW*, and *8T–8Y*.
- Jamaica uses 6Y
- Japan uses *JA–JS*, *7J–7N*, and *8J–8N*.
- New Zealand uses *ZK–ZM*.
- Russia uses *R* and *UA–UI*.
- United Kingdom uses *G*, *M*, *VS*, *ZB–ZJ*, *ZN–ZO*, *ZQ*.
- United States uses *KA-KZ*, *WA-WZ*, *NA-NZ*, and *AA–AL*.
- Madagascar uses 5R.
- Zimbabwe uses Z2.

World Call Sign prefixes



United States Call Regions



Examples of Full Call Signs

- Australia VK3YAK, *VK1VZ*.
- Canada *VE7*EWK, VA3AO.
- Germany *DL7UAR,* DM2AA.
- India VU2IUA, VT5AA.
- Jamaica 6Y6AJ, 6Y5PJC.
- Japan JA7EL, 8J8XEY.
- New Zealand *ZK2UA, ZL5AAP*.
- Russia R4SAS, UA2DU.
- United Kingdom *G3MAR*, *M4ANS.*
- United States uses *KA4ABA, W5FRS, WJ9H, AA5TX*
- Madagascar 5R2IA.
- Zimbabwe Z23U.

Amateur Radio Call Signs

- ***From FCC rules:*** *call signs are in the international series and normally consist of a one, two or three character prefix, a number (which may be used to denote a geographical area, identify the call sign as belonging to the amateur service, or identify a licensee as a visitor or temporary resident), and a 1, 2, or 3 character suffix. This suffix may be followed by a further suffix, such as /P (portable), /M (mobile), or /MM (maritime mobile). The number following the prefix is normally a single number (0 to 9).*
- U.S. Examples – N 5 HYP / P9
  KE 5 KPC / M4

Wikipedia

Amateur Radio Call Signs

- Today we have permission to use a very special call sign

K2BSA/5

- A special thanks to Jim Wilson, K5ND, the K2BSA trustee for allowing us to use this call sign today.

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Use of Phonetic Alphabet

- English is the international language of Amateur Radio.
- Use of phonetic alphabet allows for easier understanding of the spelling of words or call signs.
- Military phonetics are the standard but non-standard phonetics can be used.

The Phonetic Alphabet

A = ALPHA ._	N = NOVEMBER _.
B = BRAVO _...	O = OSCAR _ _ _
C = CHARLIE _._.	P = PAPA ._ _.
D = DELTA _..	Q = QUEBEC _ _ ._
E = ECHO .	R = ROMEO ._.
F = FOXTROT .._.	S = SIERRA ...
G = GOLF _ _.	T = TANGO _
H = HOTEL	U = UNIFORM .._
I = INDIA ..	V = VICTOR ..._
J = JULIET ._ _ _	W = WHISKEY ._ _
K = KILO _._	X = X-RAY _.._
L = LIMA ._..	Y = YANKEE _._ _
M = MIKE _ _	Z = ZULU _ _..

Radio Merit Badge Requirements

- 3. Do the following:
  - a. Draw a chart of the electromagnetic spectrum covering 100 kilohertz (kHz) to 1000 megahertz (MHz).
  - b. Label the LF, MF, VHF, UHF, and microwave portions of the spectrum on your diagram.
  - c. Locate on your chart at least eight radio services such as AM and FM commercial broadcast, CB, television, amateur radio (at least four ham radio bands), and police.

The Electromagnetic Spectrum

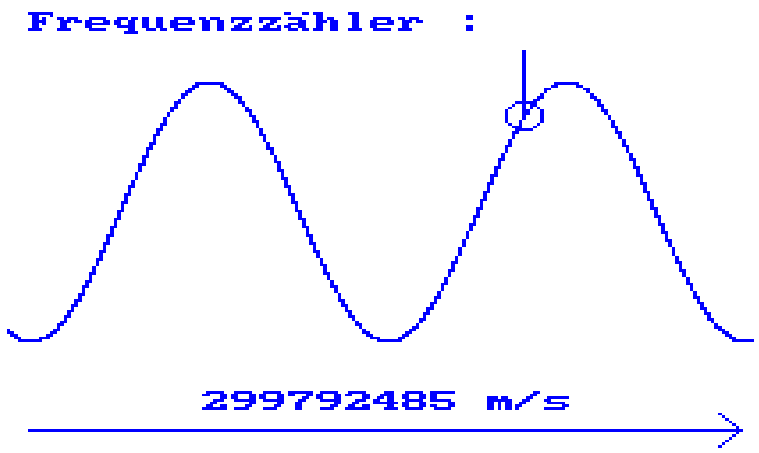
- Radio waves, visible light and cosmic rays are all part of the **Electromagnetic spectrum.**
- The speed of light in free space is **300 million meters per second.**
- Radio waves are classified by either the **Frequency** of their alternation or alternatively, by the distance between oscillations, **Wavelength**.

Wavelength and Frequency

- Visible light is composed of different frequencies, infrareds and reds are lower than blues and ultraviolet.
- A PRISM causes the different frequencies to bend at different angles.

Wavelength and Frequency

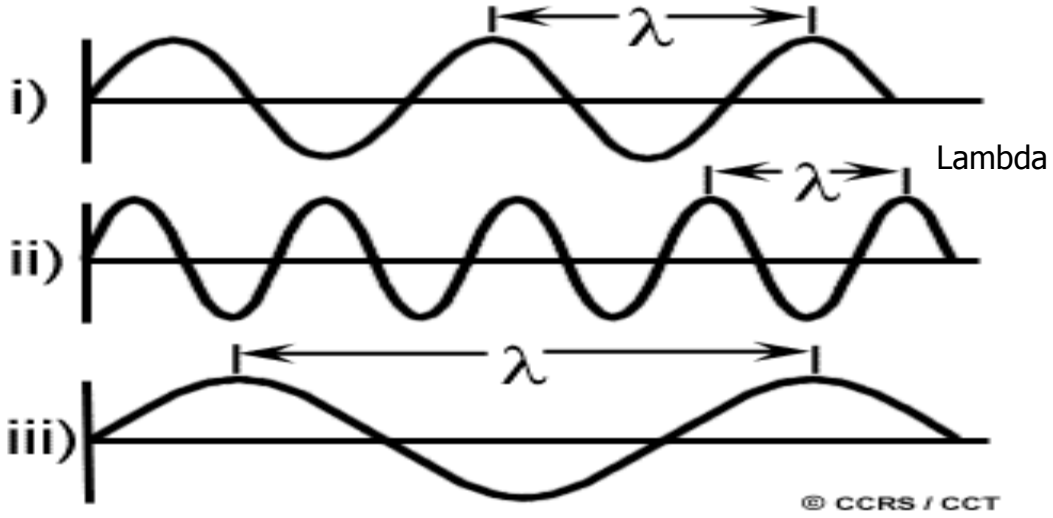
- Wavelength is determined by measuring the distance between the peaks of a sign wave.



http://users.nlamerica.com/kevin/Freq.htm

Wavelength and Frequency

- Frequency and wavelength have an inverse relationship. As frequency gets higher, wavelength gets smaller. This because the speed of light stays the same.



http://ccrs.nrcan.gc.ca/resource/tutor/fundam/chapter1/02_e.php

Wavelength and Frequency

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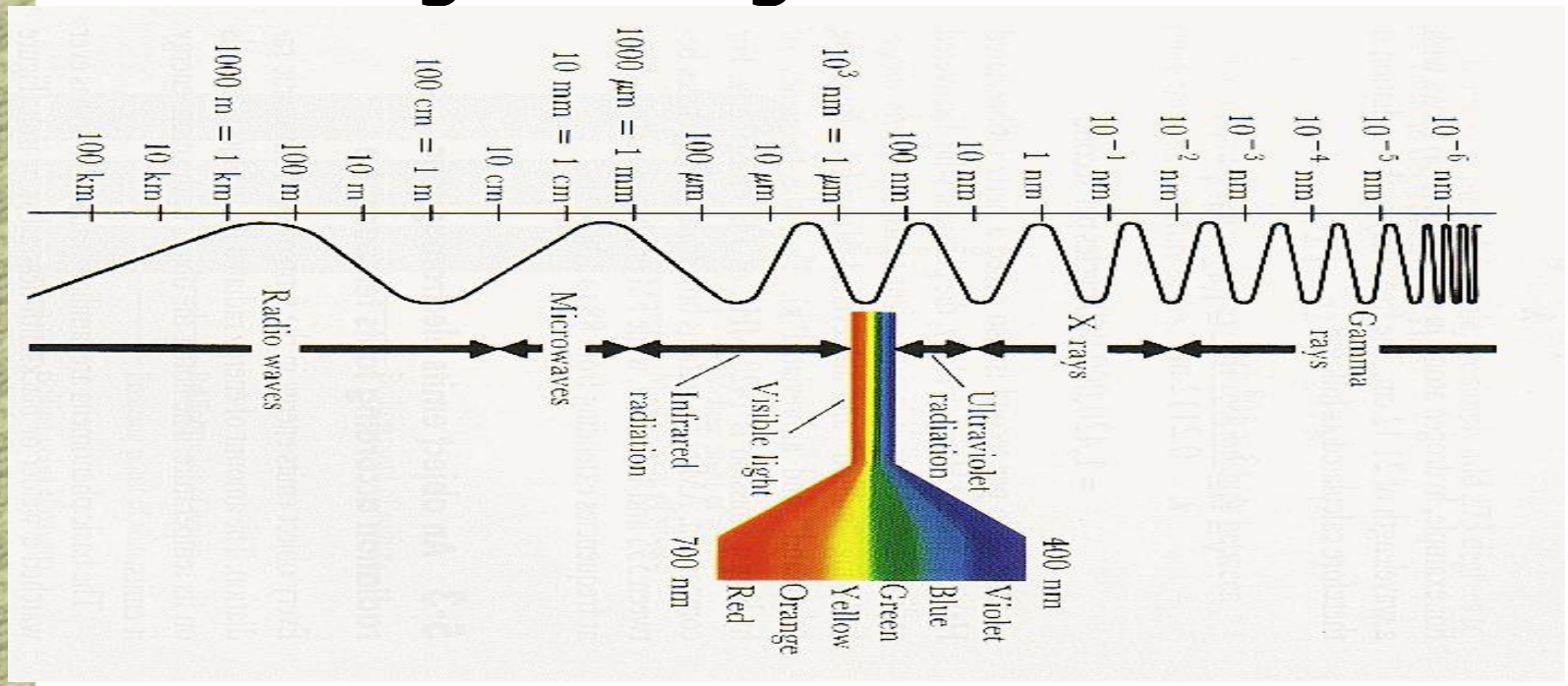
Wavelength and Frequency

- So as frequency gets higher the wavelength will get shorter



Wavelength and Frequency

- Basic unit of frequency is the Hertz.
- 1 Hertz (Hz) = 1 complete cycle of a sign wave. Per second
- 1KHz (Kilohertz) = 1,000 Hz
- 1MHz (Megahertz) = 1,000,000 Hz
- 1GHz (Gigahertz) = 1,000,000,000 Hz
- Named after Heinrich Hertz (1857-1894)

Wavelength and Frequency

- Knowing the speed of light is 300 Meters per second, if you know either the frequency or wavelength, you can find the other.
  - FREQUENCY OF OSCILLATION x WAVELENGTH = SPEED OF LIGHT

$$\text{Wavelength} = \frac{\text{Speed of Light (Constant)}}{\text{Frequency of Oscillation}}$$

$$\text{Frequency of Oscillation} = \frac{\text{Speed of Light (Constant)}}{\text{Wavelength}}$$

http://www.qrg.northwestern.edu/projects/vss/docs/Communications/2-how-are-frequency-and-wavelength-related.html

Wavelength and Frequency

- Example; We know the frequency to be 30 Megahertz, (30,000,000) we can calculate the wavelength in meters.

$$\frac{\text{300 (Million Meters per Sec)}}{\text{30 (Million Hertz) MHz}} = \textbf{10 Meters}$$

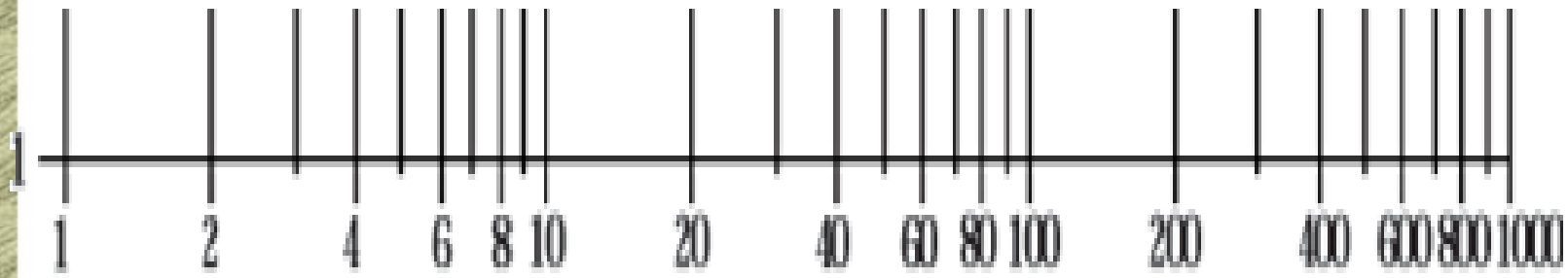
Wavelength and Frequency

- Example; We know the wavelength to be 20 Meters, we can calculate the frequency in Mega Hertz (MHz).

$$\frac{300 \text{ (Million Meters per Sec)}}{20 \text{ Meters}} = \textbf{15 MHz}$$

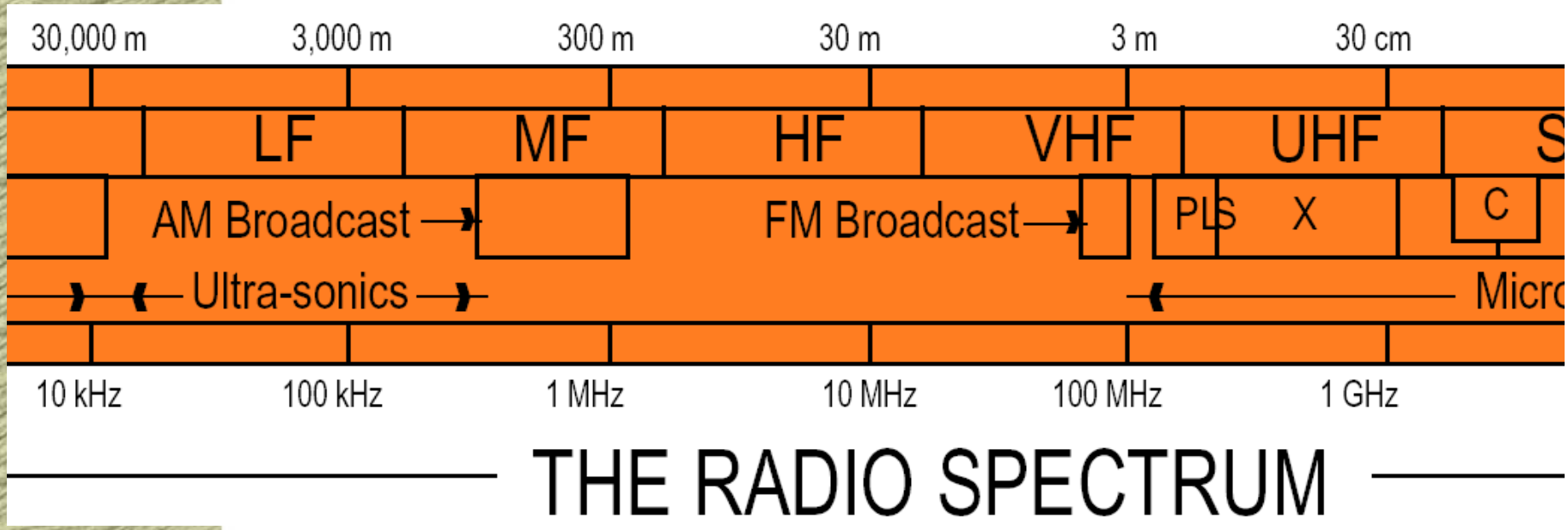
Wavelength and Frequency

- Frequency can be plotted on a logarithmic scale. This as opposed to a linear scale.



Frequency

Wavelength and Frequency



UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

- AERONAUTICAL MOBILE
- AERONAUTICAL MOBILE SATELLITE
- AERONAUTICAL RADIONAVIGATION
- AMATEUR
- AMATEUR SATELLITE
- BROADCASTING
- BROADCASTING SATELLITE
- EARTH EXPLORATION SATELLITE
- FIXED
- FIXED SATELLITE
- INTER-SATELLITE
- LAND MOBILE
- LAND MOBILE SATELLITE
- MARITIME MOBILE
- MARITIME MOBILE SATELLITE
- MARITIME RADIONAVIGATION
- METEOROLOGICAL
- METEOROLOGICAL SATELLITE
- MOBILE
- MOBILE SATELLITE
- RADIO ASTRONOMY
- RADIODETERMINATION SATELLITE
- RADIOLOCATION
- RADIOLOCATION SATELLITE
- RADIONAVIGATION
- RADIONAVIGATION SATELLITE
- SPACE OPERATION
- SPACE RESEARCH
- STANDARD FREQUENCY AND TIME SIGNAL
- STANDARD FREQUENCY AND TIME SIGNAL SATELLITE

ACTIVITY CODE

- GOVERNMENT EXCLUSIVE
- GOVERNMENT/NON-GOVERNMENT SHARED
- NON-GOVERNMENT EXCLUSIVE

ALLOCATION USAGE DESIGNATION

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

This chart is a graphic single-point-in-time portrayal of the Table of Frequency Allocations used by the FCC and NTIA. As such, it does not completely reflect all aspects, i.e. footnotes and recent changes made to the Table of Frequency Allocations. Therefore, for complete information, users should consult the Table to determine the current status of U.S. allocations.

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

August 2011

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512-1800; Washington, DC area (202) 512-1800
Fax: (202) 512-2250 Mail: Stop SSOP, Washington, DC 20402-0001

PLEASE NOTE: THE SPACING ALLOTTED THE SERVICES IN THIS SPECTRUM SEGMENT IS DETERMINED BY MANY PROMOTIONAL AS TO THE ACTUAL AMOUNT OF SPECTRUM OCCUPIED.

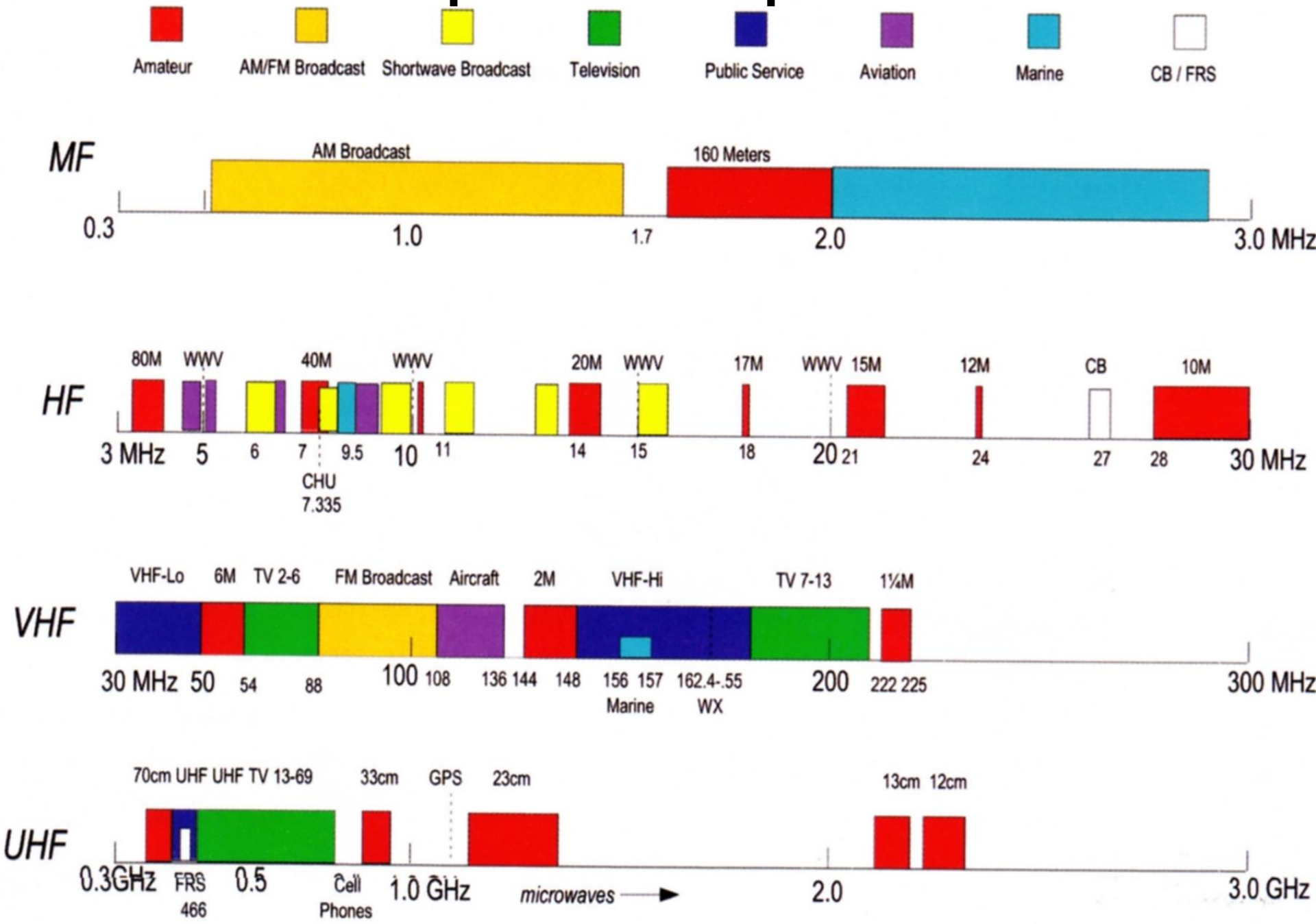
RADIO SERVICES COLOR LEGEND

ACTIVITY CODE

ALLOCATION USAGE DESIGNATION

SERVICE	EXAMPLE	DESCRIPTION
Primary	FIXED	Capital Letters
Secondary	Mobile	1st Capital with lower case letters
Permitted	/BROADCASTING/	Capital Letters between oblique strokes

Simplified Radio Spectrum



Radio Merit Badge Requirements

- 2. Do the Following;
  - a. Sketch a diagram showing how radio waves travel locally and around the world.
  - b. Explain how the broadcast radio stations, WWV and WWVH can be used to help determine what you will hear when you listen to a shortwave radio?
  - c. Explain the difference between a DX and a local station.
  - d. Discuss what the Federal Communication Commission (FCC) does and how it is different from the International Telecommunication Union.

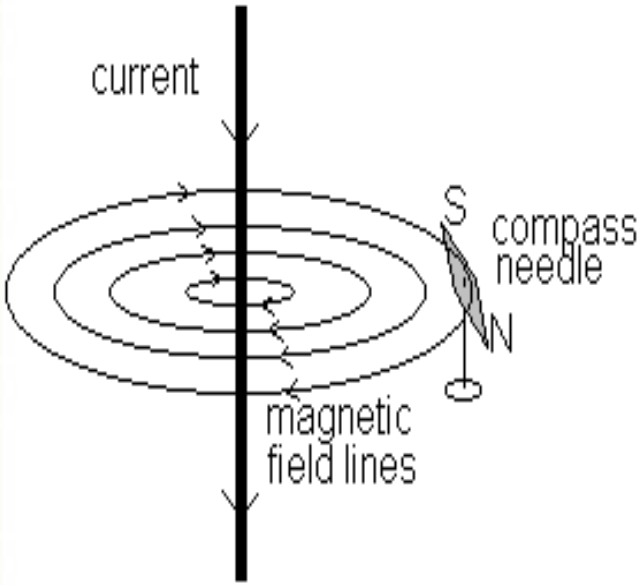
What Are Radio Waves?

- **Radio waves** are electromagnetic waves occurring on the radio frequency portion of the electromagnetic spectrum. A common use is to transport information through the atmosphere or outer space without wires.
- Radio waves are distinguished from other kinds of electromagnetic waves by their wavelength. Radio waves have a relatively long wavelength in the electromagnetic spectrum as compared to visible light or cosmic rays.

Wikipedia

How are radio waves propagated?

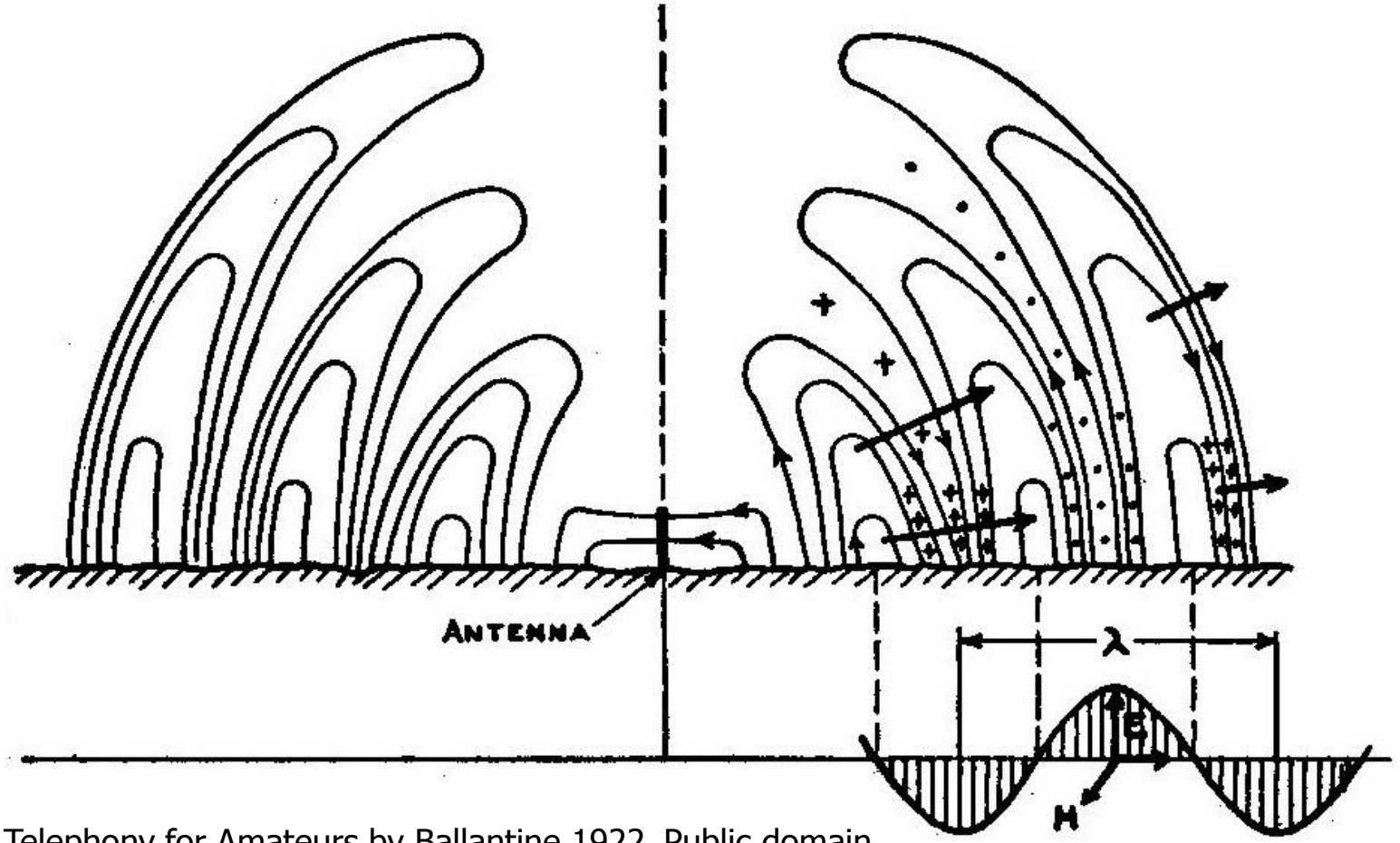
- A current passing through a wire produces a magnetic field.



- If an open ended wire called an Antenna is fed with an alternating current, it will send out waves of electromagnetic radiation

www.physics.gla.ac.uk/.../PubSci/exhibits/E2/

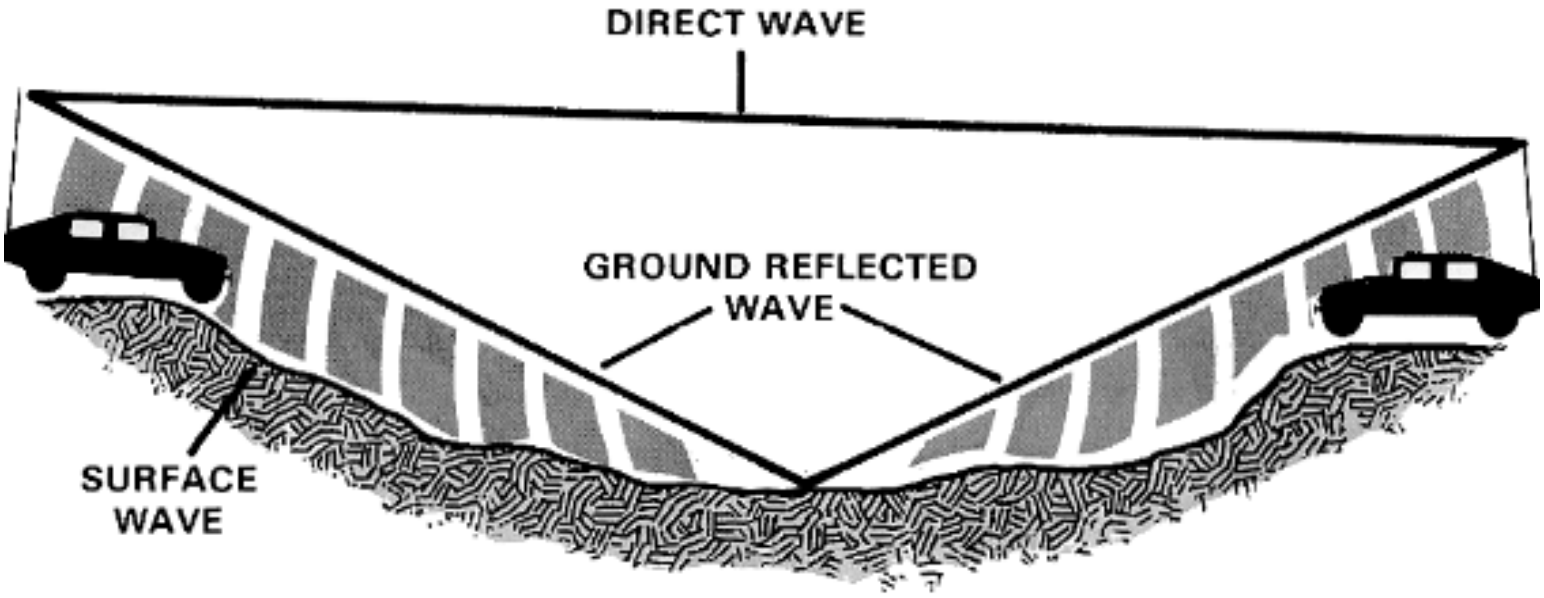
How are radio waves propagated?



Copied from Radio Telephony for Amateurs by Ballantine 1922 Public domain

How are radio waves propagated?

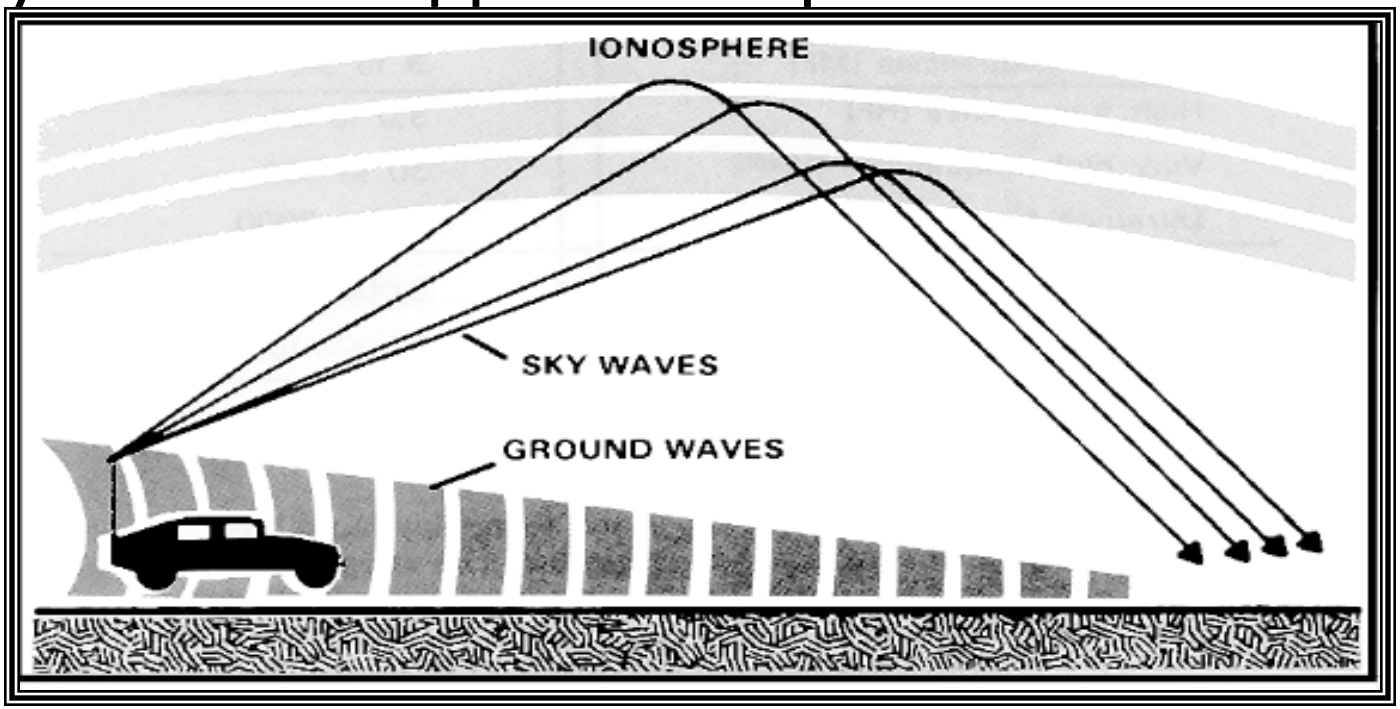
- Depending on frequency, radio waves can travel in any of three ways
- Direct waves,
- Ground waves,



ARRL Amateur Radio Handbook, ©2005

How are radio waves propagated?

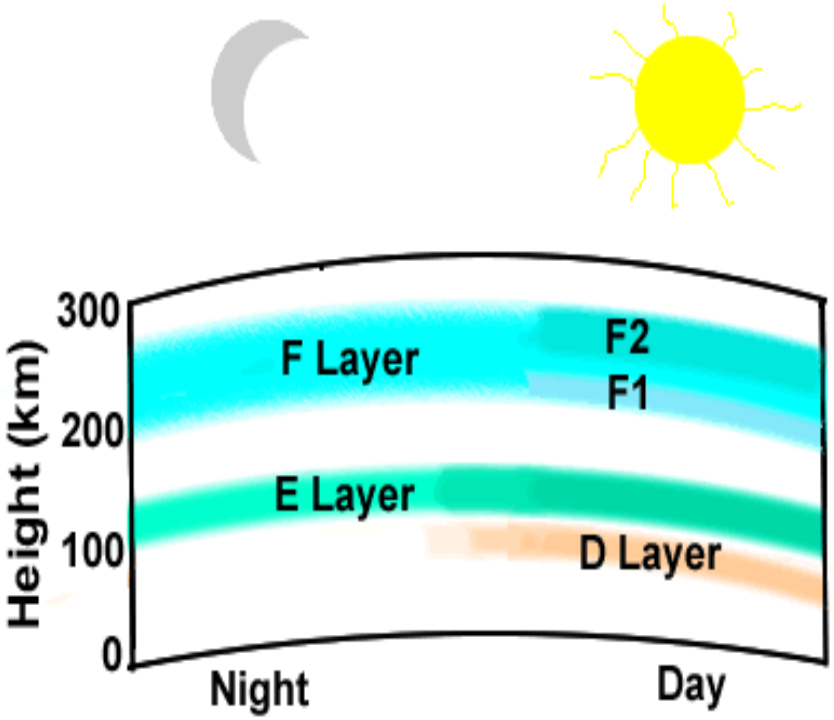
- Sky Waves.
- Sky waves reflect off the Earth and energized layers of the upper atmosphere



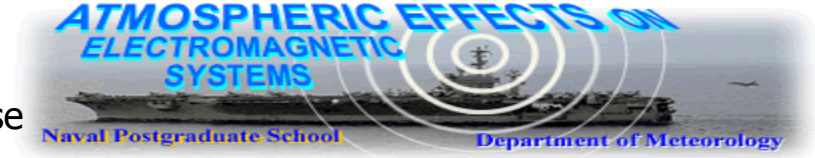
Amateur Radio Handbook, 2005, ARRL

How are radio waves propagated?

- The Ionosphere is from about 60-300 miles high in the upper atmosphere
- Affected by solar radiation, it can become reflective to certain frequencies of radio waves.

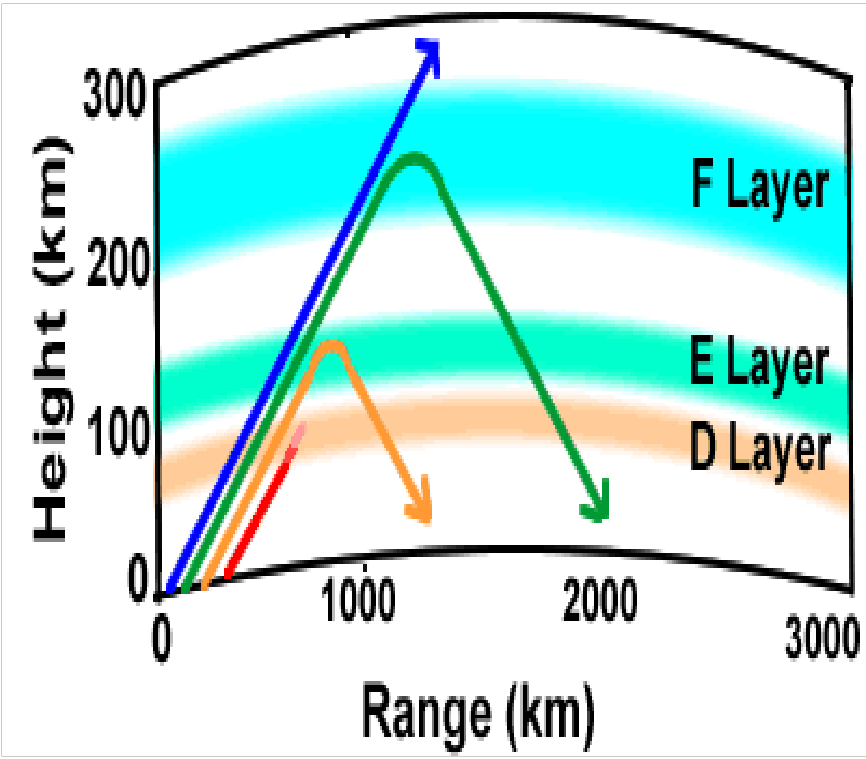


Source: US Navy On-line course



How are radio waves propagated?

- Higher frequencies might pass through the ionosphere directly into space.
- Lower frequencies may reflect off of lower, denser layers.
- Even lower frequencies can be absorbed and never make it to a receiver.



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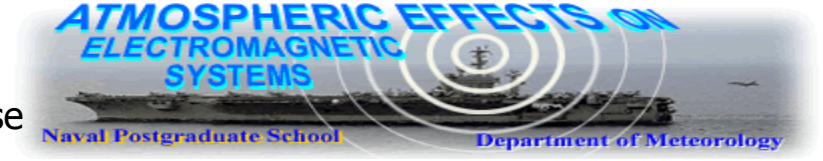
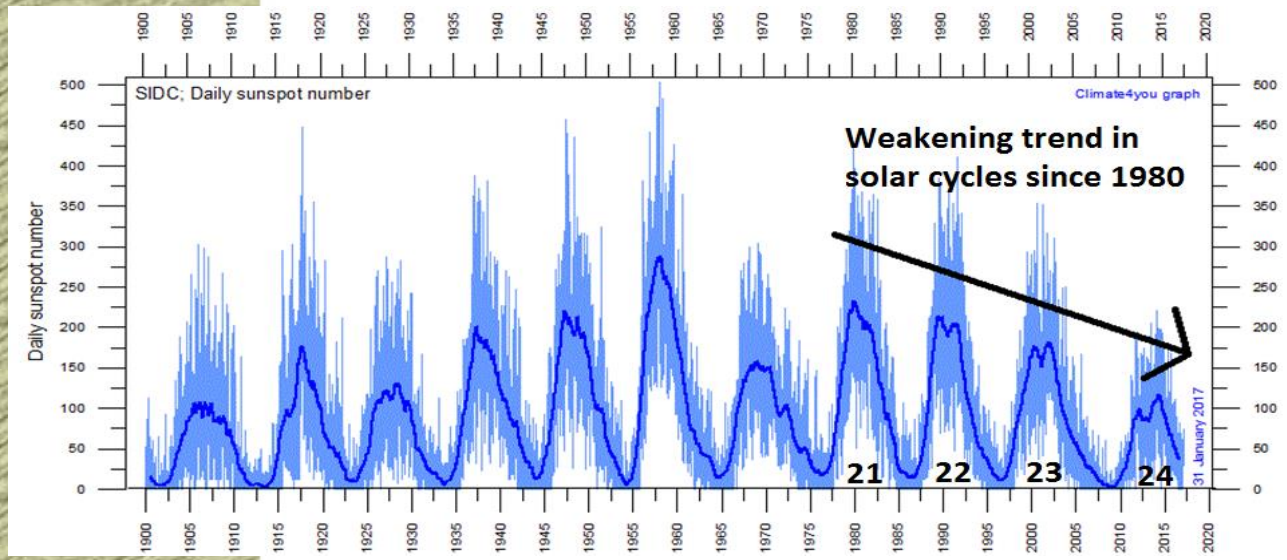
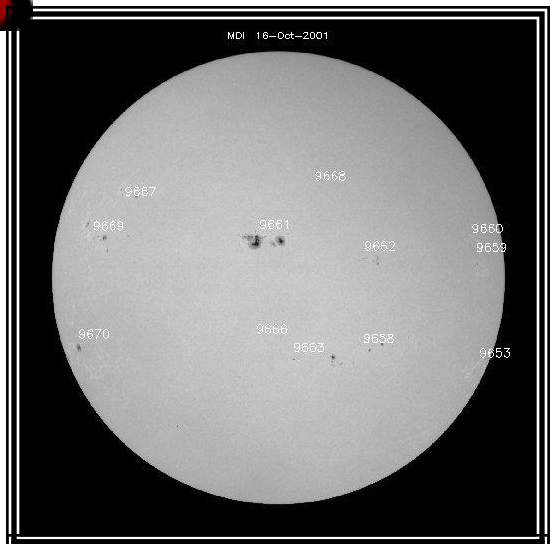
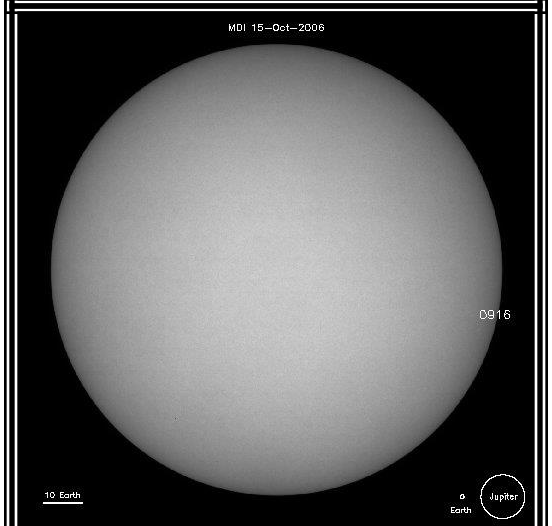


How are radio waves propagated?

- Sunspots cause UV radiation and that radiation energizes the Ionosphere.
- Sunspot numbers vary in an 11 year cycle.

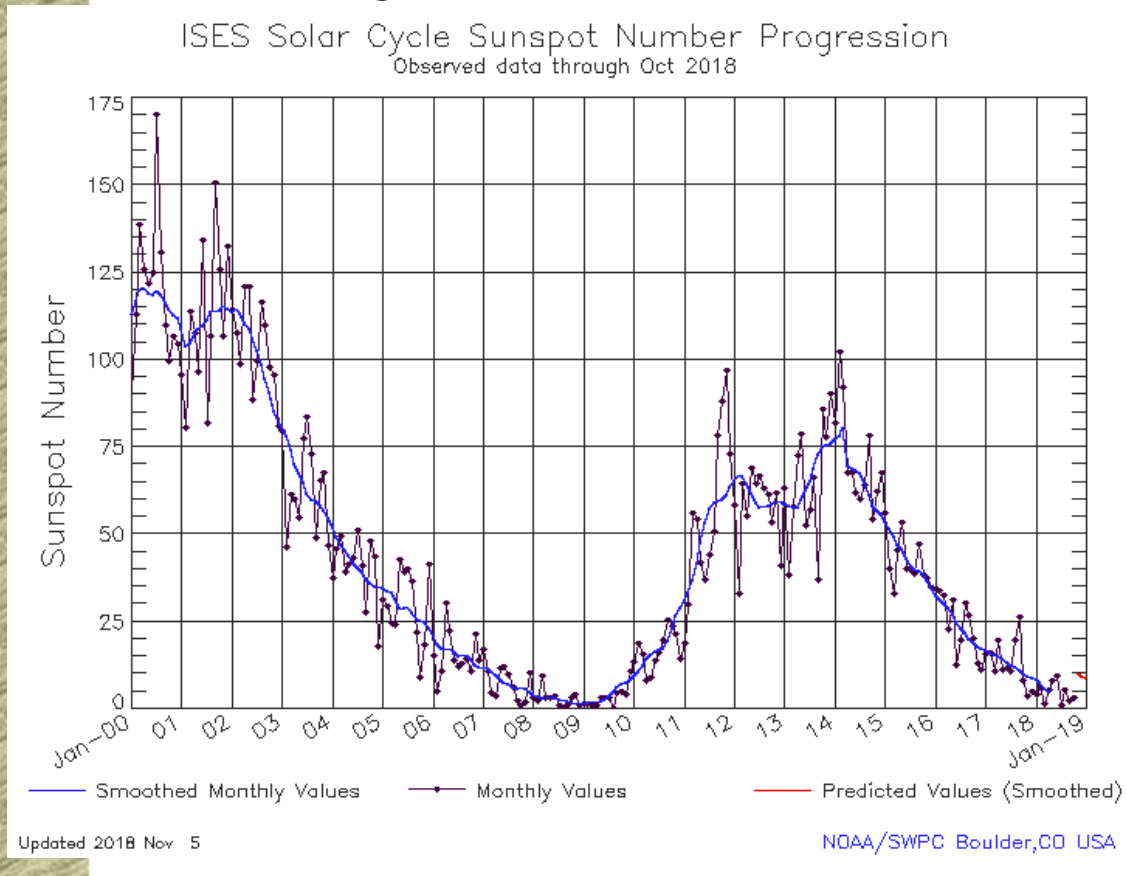


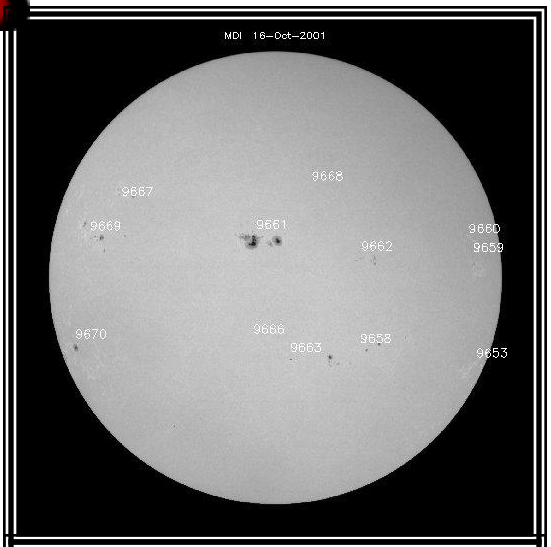


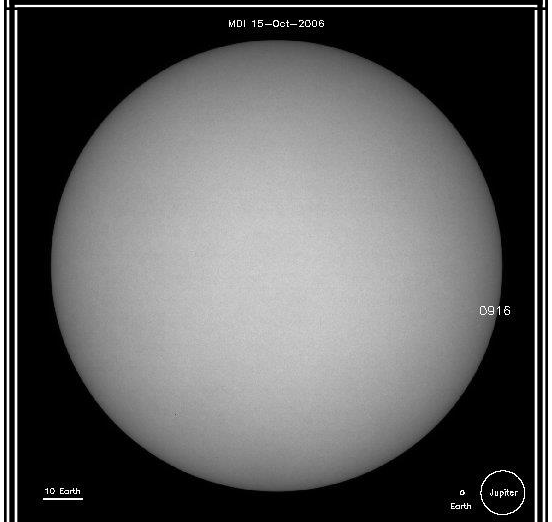


How are radio waves propagated?

- Solar Cycle 24 is down from it's peak now and has proved to be much weaker than 23. Nearing the bottom.

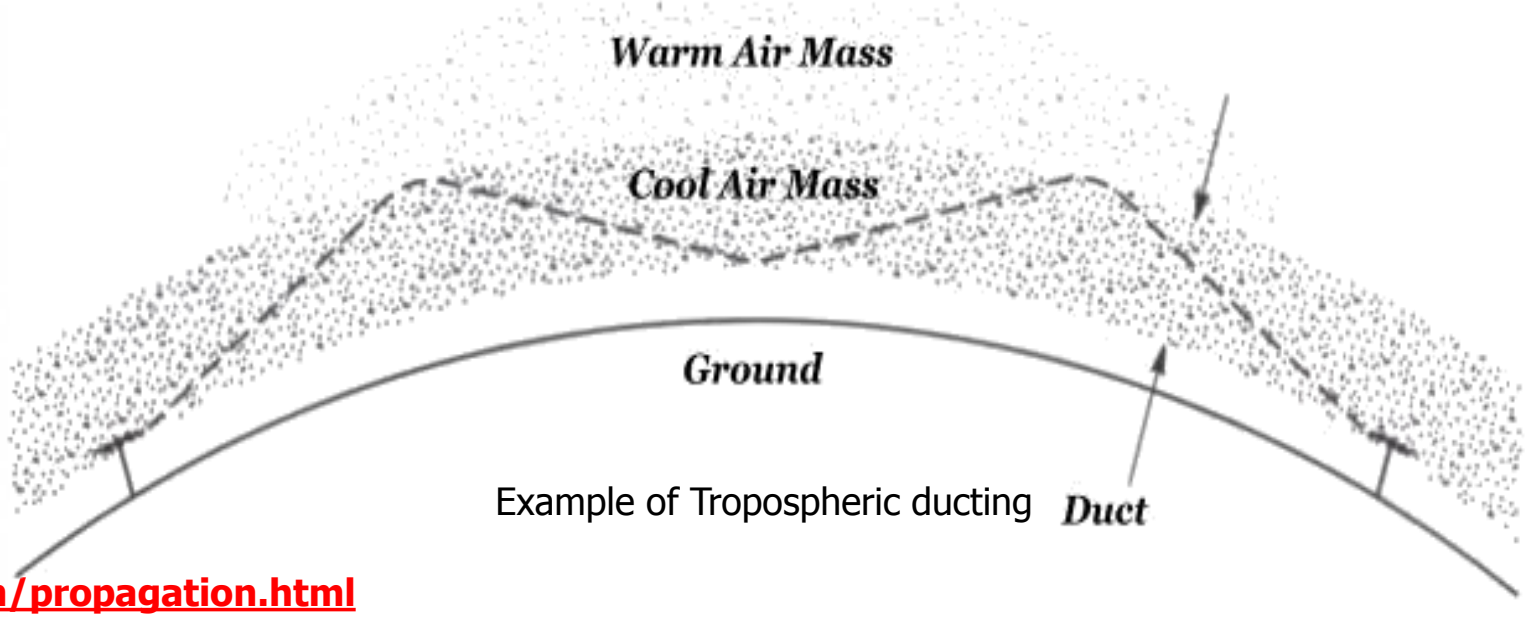






How are radio waves propagated?

- Higher frequency radio waves like VHF and UHF, will pass through the ionosphere, but may be reflected by boundary layers in the lower atmosphere. *Temperature inversions*.



Example of Tropospheric ducting

ham-shack.com/propagation.html

How do we know if our transmission will get through?

- **Line of sight, *Direct Waves* are the easiest.**
- Do you have enough height to make the distance. The more height the further to the horizon.
- Are there obstructions in the way that can hinder the radio signal.
- Additional transmitter power can help but unless the signal is reflected, it will not travel over the horizon.

How do we know if our transmission will get through?

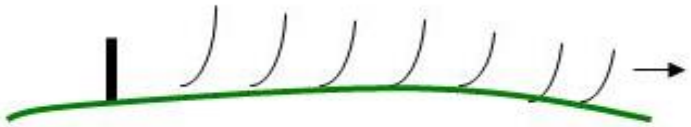
- ***Ground Wave*** **can be effective for longer distances.**
- The lower the frequency, the longer the ground wave distance.
- The type of earth surface determines effectiveness.
- Salt water, moist ground, dry ground rocky mountainous terrain go from best to worst for Ground Waves.

How do we know if our transmission will get through?

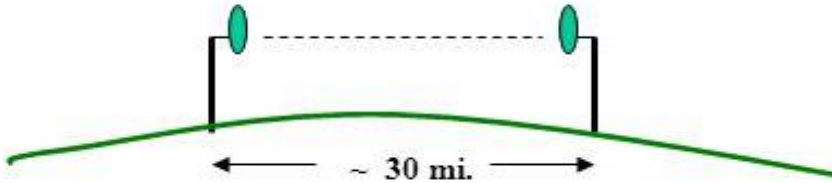
- ***Sky Waves*** **can travel thousands of miles.**
- Frequency of transmission, time of day, location and solar activity all affect how and when the best conditions will be for long distance communications.
- Solar flares and geomagnetic storms can actually cause blackouts of HF radio communications.
- Multi-Hop paths are very common.

Primary Propagation Modes

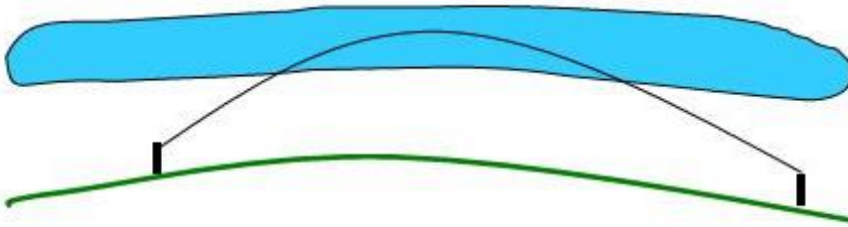
- **Ground wave**
  - AM BC band daytime; HF across town



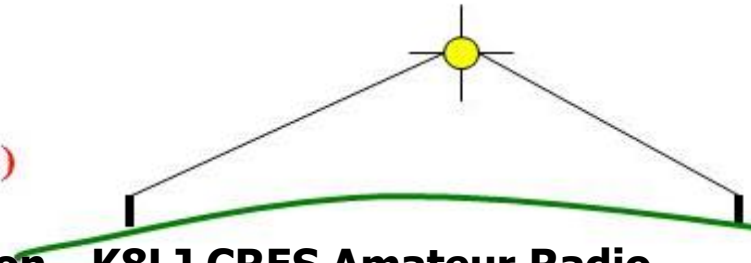
- **Space wave**
  - Point to point (ground not involved)



- **Sky wave** ***(the focus of this presentation)***
  - Refraction via the ionosphere
  - Makes world-wide communications possible



- **Satellite communications**
  - Artificial propagation (repeater in the sky)



Wave Propagation Presented by: Bob Kenyon - K8LJ CRES Amateur Radio Club 4/22/2008.

WWV and WWVH

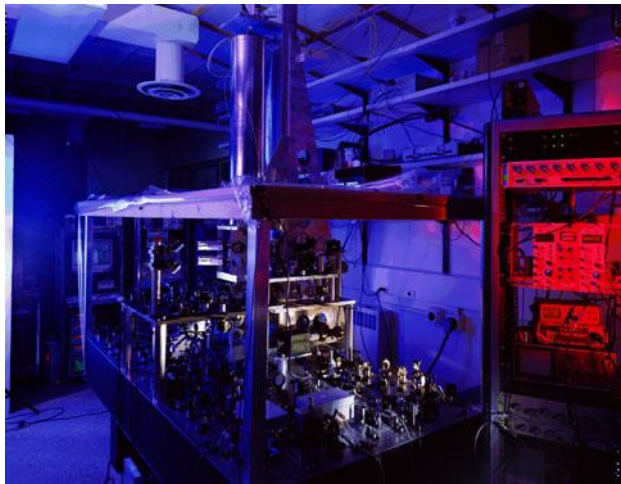
- Many countries provide national time and frequency standards radio stations.
- The US NIST provides WWV, WWVH and WWVB for this purpose.
- WWV is located in Ft. Collins, Colorado.
- WWVH is located in Hawaii.
- Both stations broadcast on standard frequencies of 2.5, 5, 10, 15, 20 and 25 MHz

WWV and WWVH

- Both stations broadcast atomic clock accurate time.
- Amongst other things, they regularly broadcast reports of propagation conditions and solar/geomagnetic activity.
- By tuning a radio receiver to one of these frequencies, you can tell if Sky Wave propagation is possible.
- Sometimes you may hear both stations on the same frequency at the same time.

WWV and WWVH

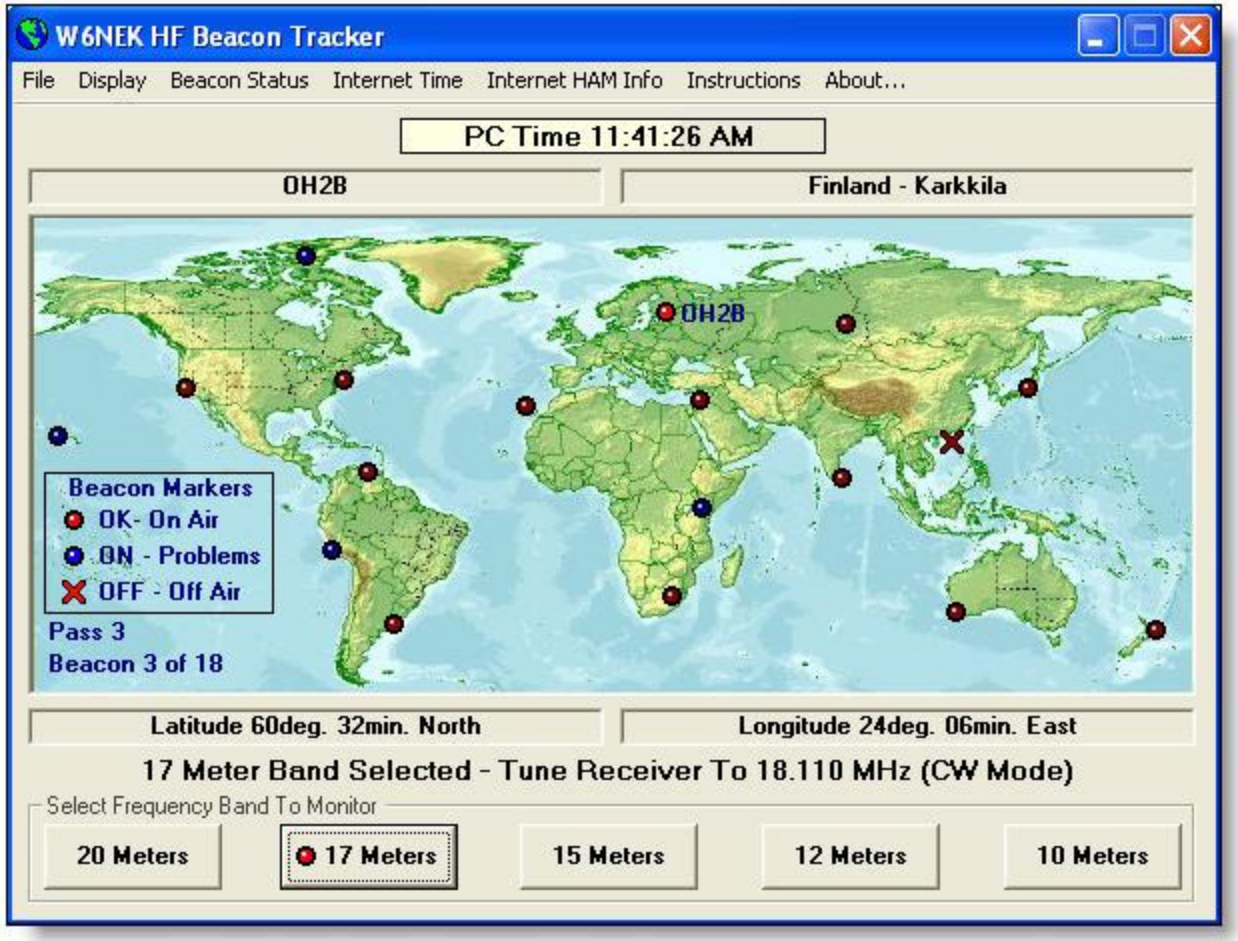
- Both stations are also primary frequency standards
- They are driven from NIST's "Atomic Clock" (Cesium Fountain) with accuracy to one second every 100 Million years.
- Signal can be used to calibrate equipment.



WWVB at VLF (Very Low Frequency)

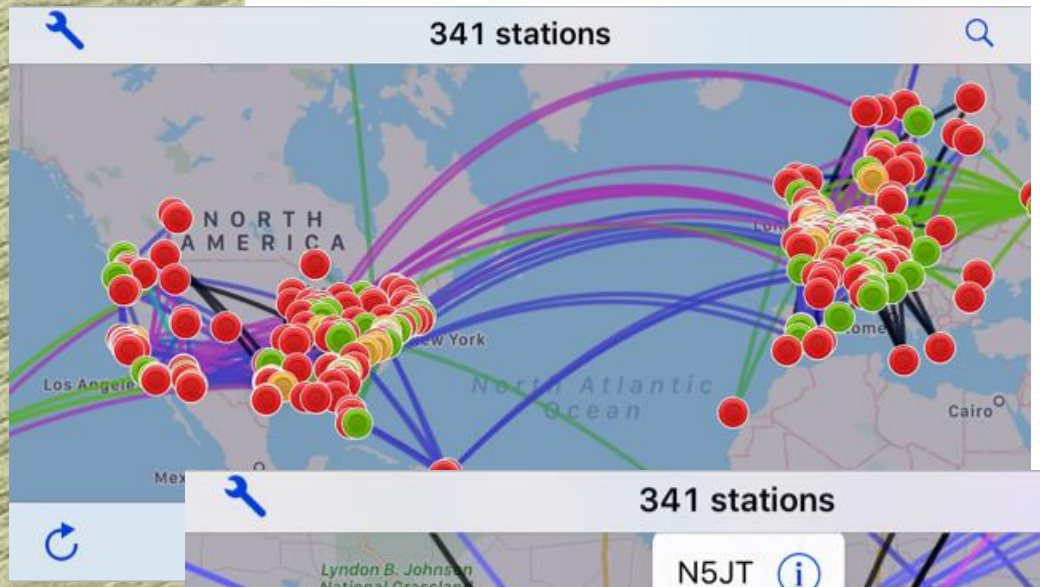
- Clocks built with special VLF receivers can listen to WWVB, also from Fort Collins, CO.
- WWVB transmits at **60KHz**. These low frequencies get to us by **"Ground Wave"** and are best received at night.
- Receiver sees data on signal and sets clock.

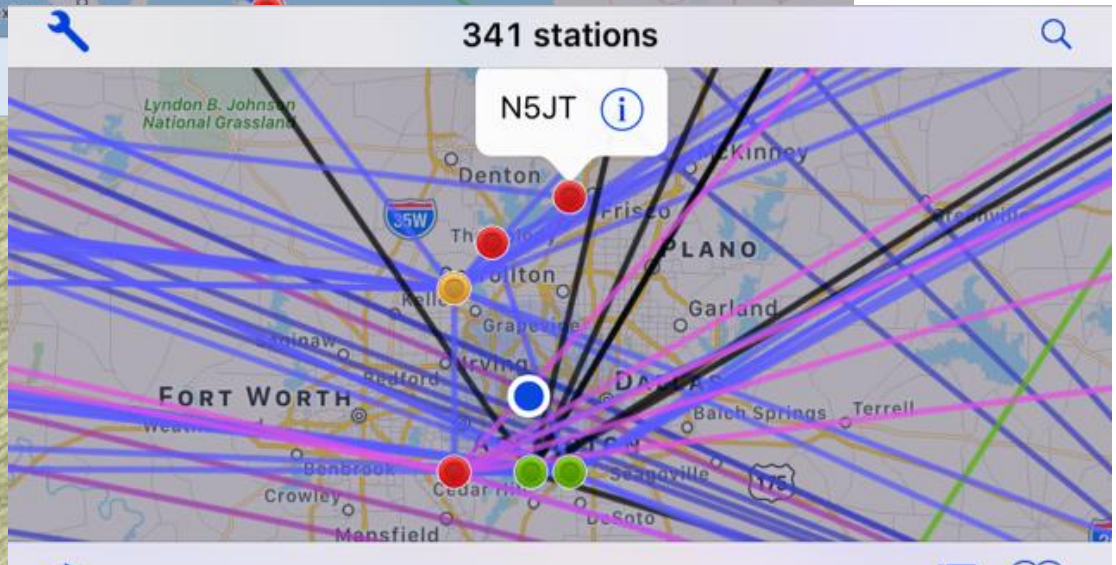
A Better way to view real time band conditions.



- **Reverse Beacon Network: HF Propagation beacons and computer software to track them.**
- Worldwide network run with GPS time provides real-time propagation predictions for locations around the Globe.

A Better way to view real time band conditions.





- **WSPRnet, (Weak Signal Propagation Reporter**
- **Stations transmit low power data on multiple frequencies.**
- **Other stations receive and upload list of stations heard.**

Radio Merit Badge Requirements

- 2. Do the Following;
  - a. Sketch a diagram showing how radio waves travel locally and around the world.
  - b. Explain how the broadcast radio stations, WWV and WWVH can be used to help determine what you will hear when you listen to a shortwave radio?
  - c. Explain the difference between a DX and a local station.
  - d. Discuss what the Federal Communication Commission (FCC) does and how it is different from the International Telecommunication Union.

Local vs. DX (Distant Signal)

- **One band's local is another band's DX (Long Distance)**
- *A **Local Station** in radio terms is whatever is normal and easy to receive.*
- *A **DX Station** would be any signal that is not common to the local area such as from other continents or other regions.*

Local vs. DX (Distant Signal)

- **One band's local is another band's DX (Long Distance)**
- *For the lower MF and HF frequencies:* Local would be maybe as far as the ground wave components travel. Possibly several hundred miles.
- *At VHF, UHF and Microwave frequencies:* local is line of sight to the horizon. Distance determined by height of transmitting and receiving stations.

Local vs. DX (Distant Signal)

- **One band's local is another band's DX (Long Distance)**
- *For the lower MF and HF frequencies:* DX would be where the sky wave propagates. Generally in Amateur radio, DX means international reception.
- *At VHF, UHF and Microwave frequencies:* DX is any enhancement beyond line of sight, meaning over the horizon.

FCC and ITU

- All radio services are regulated to some extent or the other. In U.S. the governing body is the **FCC**, **Federal Communications Commission.**
- Internationally, the **ITU, International Telecommunications Union.** Deals with the formation of multi-national policies that govern radio as a global medium. Radio waves do not stop at national borders.

Radio Merit Badge

Lets take a break!!!!

Radio Merit Badge

Welcome back!!!!!

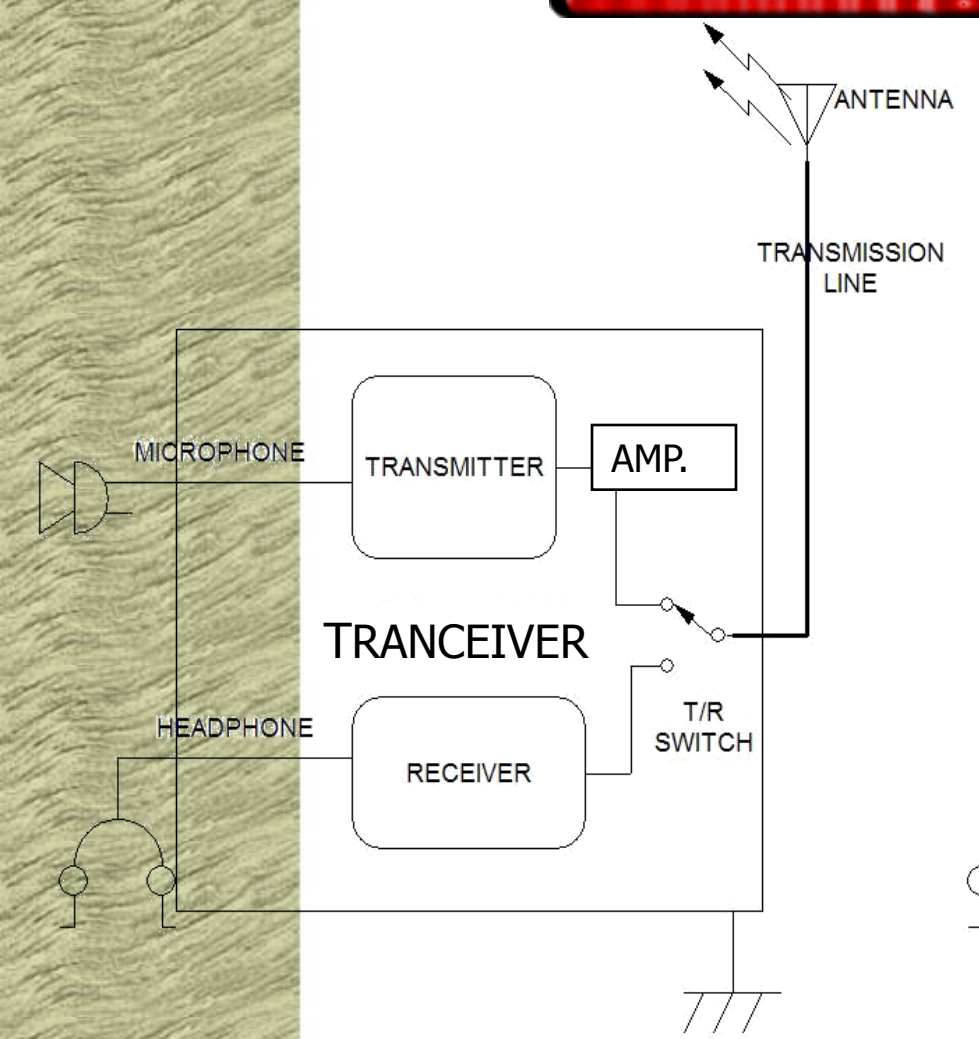
Radio Merit Badge Requirements

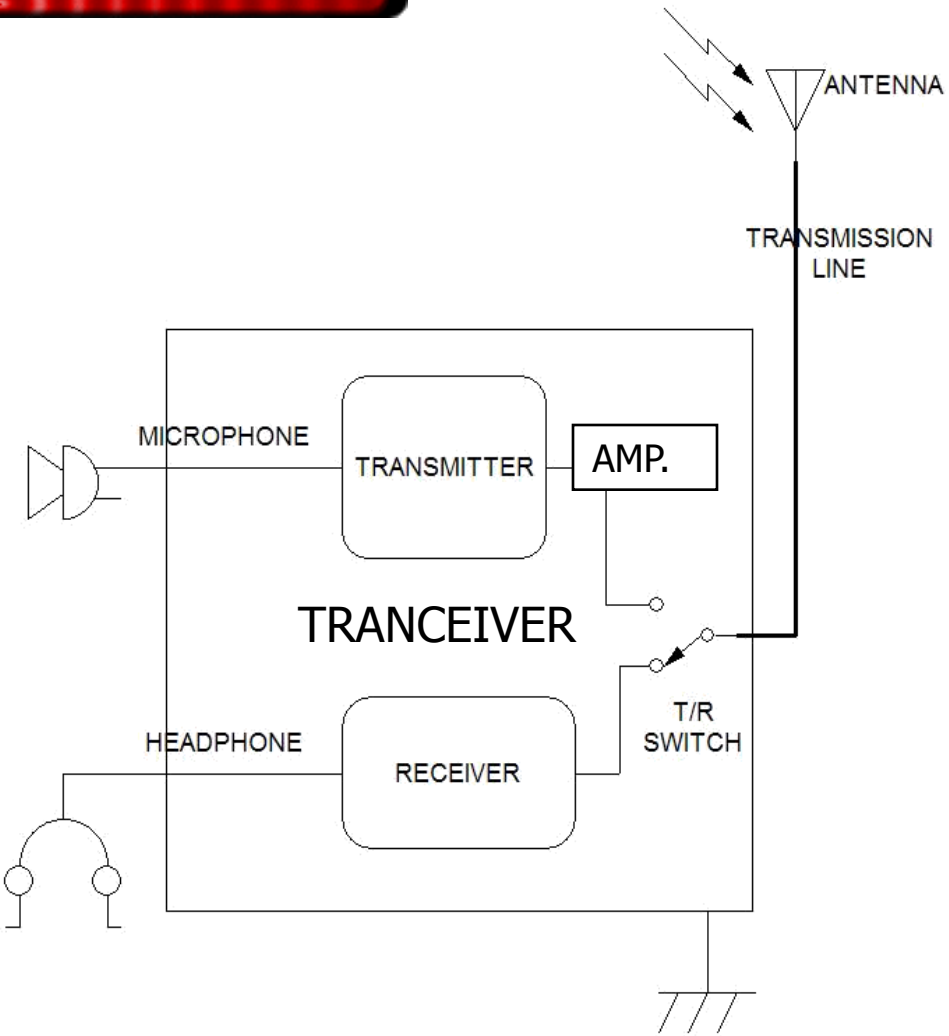
- 4. Explain how radio waves carry information. Include in your explanation: transceiver, transmitter, amplifier, and antenna.
- 5c. Discuss how information is sent when using amplitude modulation (AM), Frequency modulation (FM), continuous wave (CW) Morse Code transmission, single sideband (SSB) transmission, and digital transmission.

What makes up a radio anyway?

- A radio is any electronic device that makes and/or receives electromagnetic waves to convey information.
- This information may be data, voice/sound or picture.
- Information can be in either analog or digital forms but must be ***"modulated"*** onto a RF (Radio Frequency) carrier.

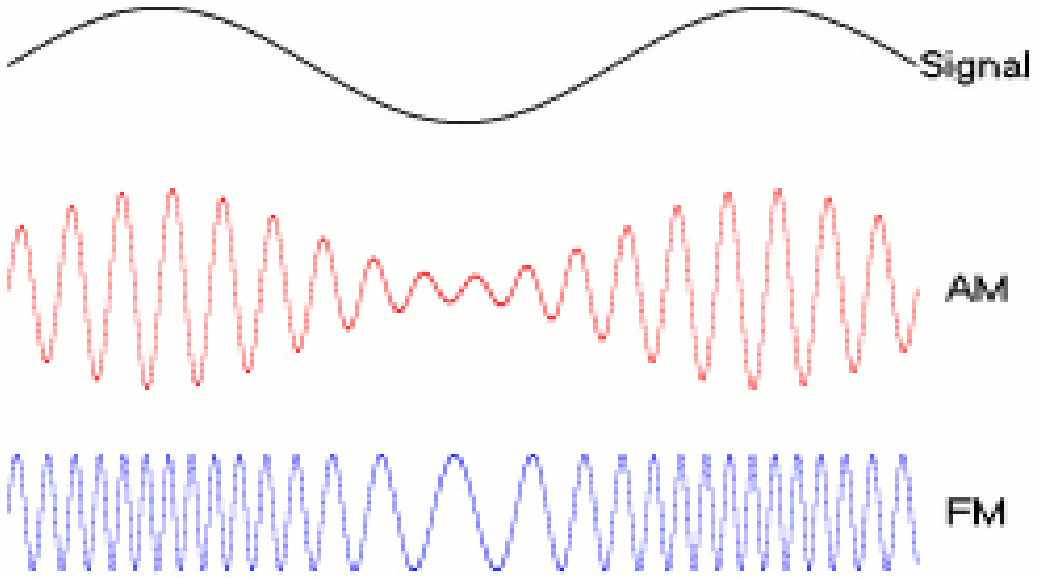
A Simple radio system





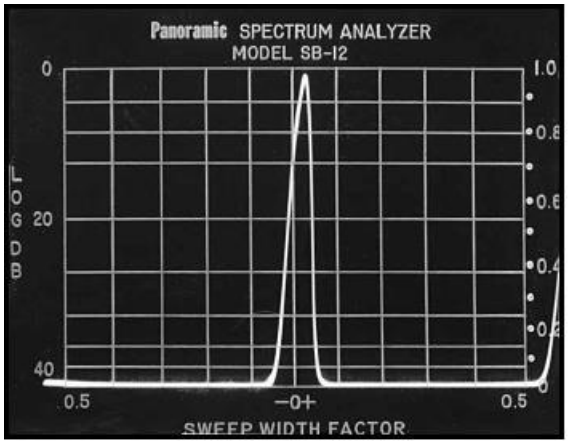
Modulation methods, AM & FM

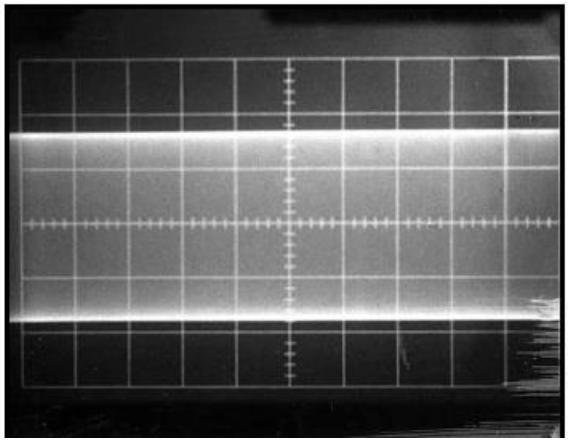
- Amplitude Modulation varies the strength of the carrier to imprint the information being sent
- Frequency Modulation varies the frequency of the carrier to imprint the information being sent.

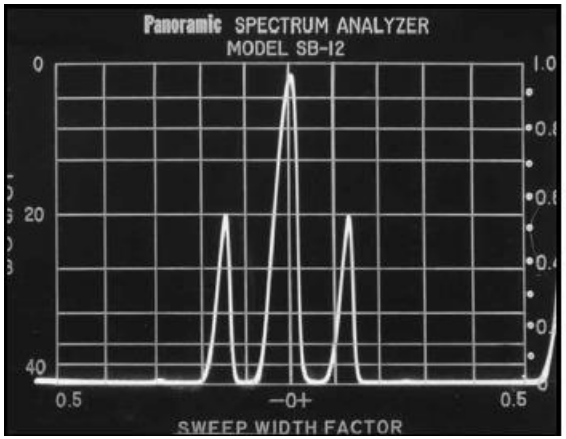


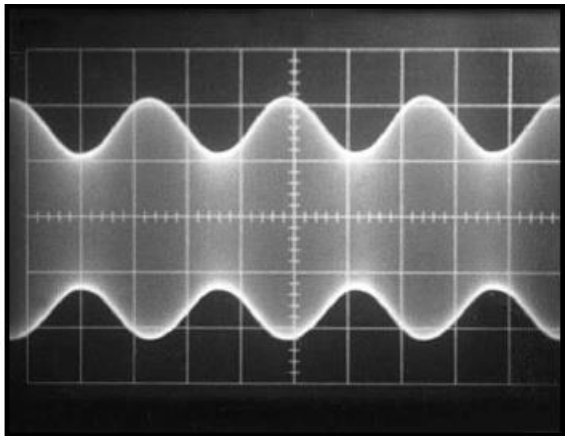
Wikipedia, Public Domain

Amplitude Modulation (AM)





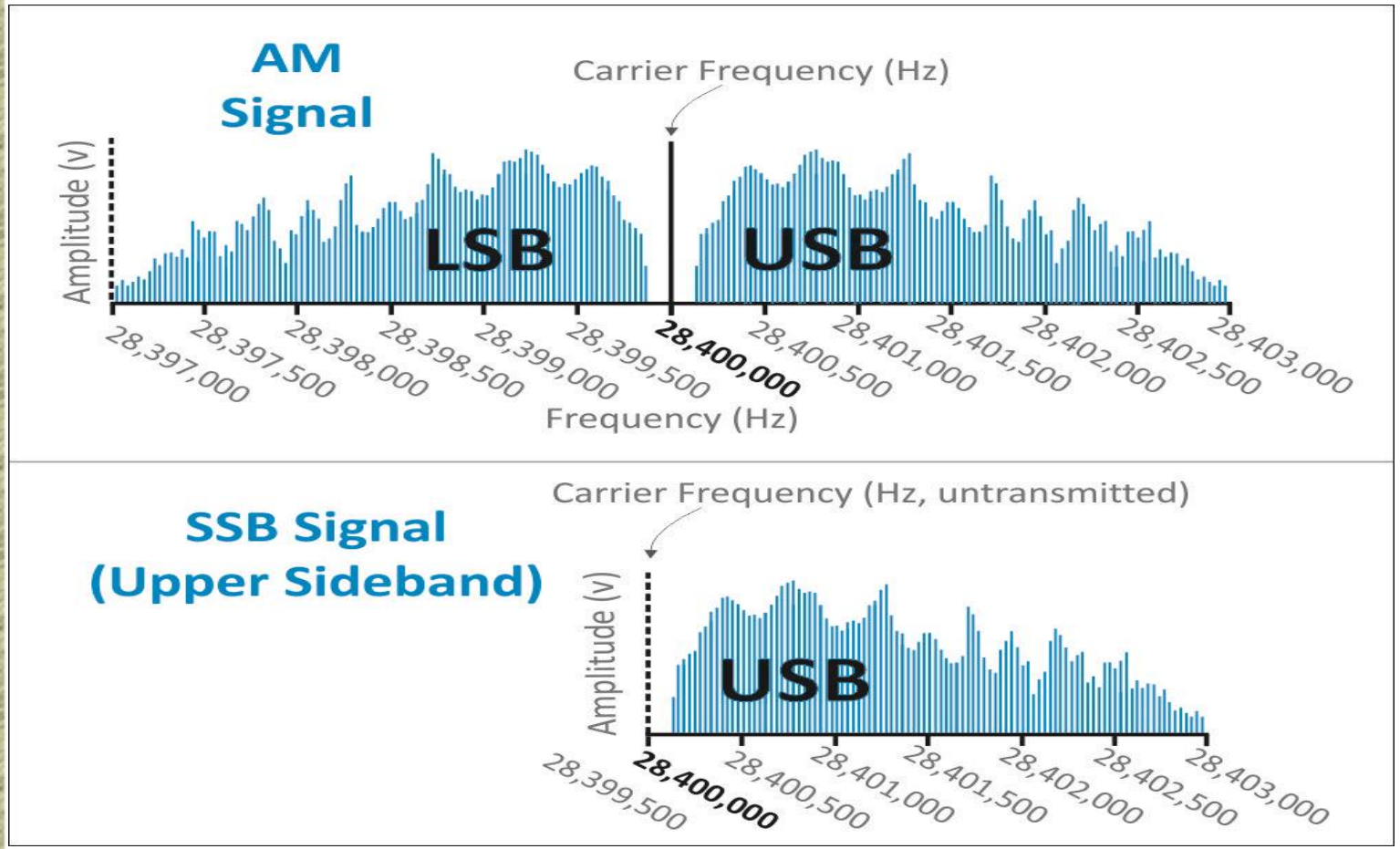




Single Side Band (SSB)

- Modified version of AM.
- The center carrier is suppressed as well as one of the two sidebands.
- Resultant single sideband is much more efficient than the old dual sideband (AM) signal.

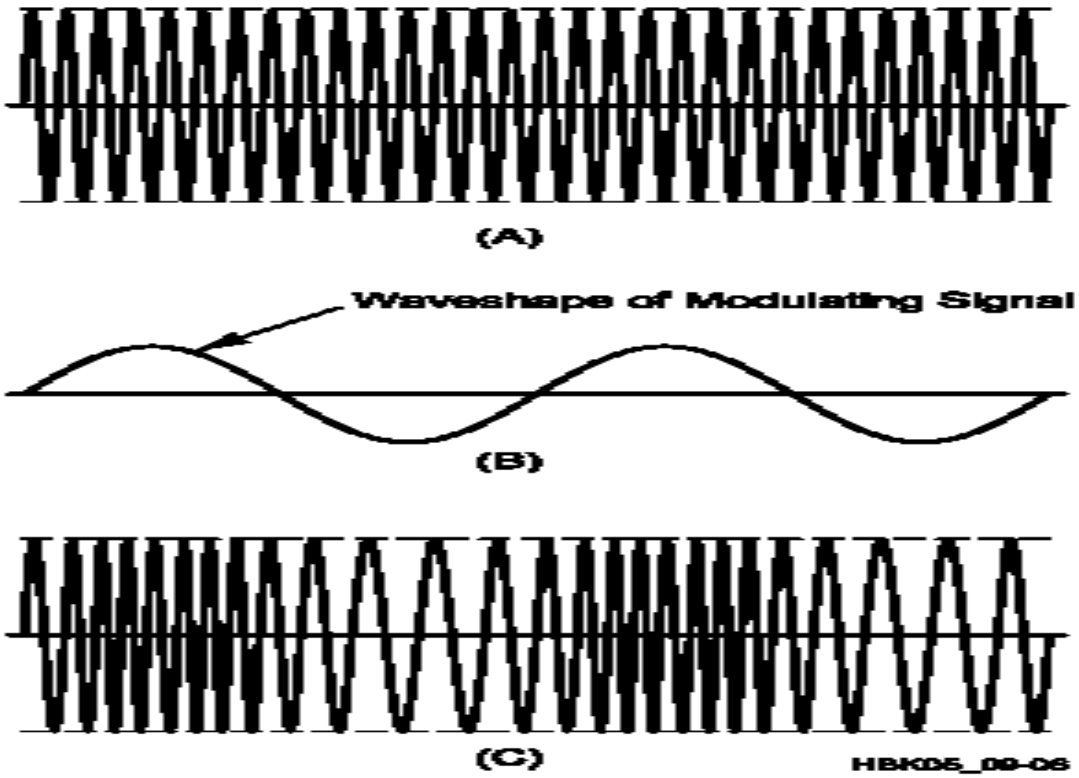
Single Side Band (SSB)



ARRL Amateur Radio Handbook, ©2005

http://www.hamradioschool.com/understanding-single-sideband-ssb-2/

Frequency Modulation (FM)

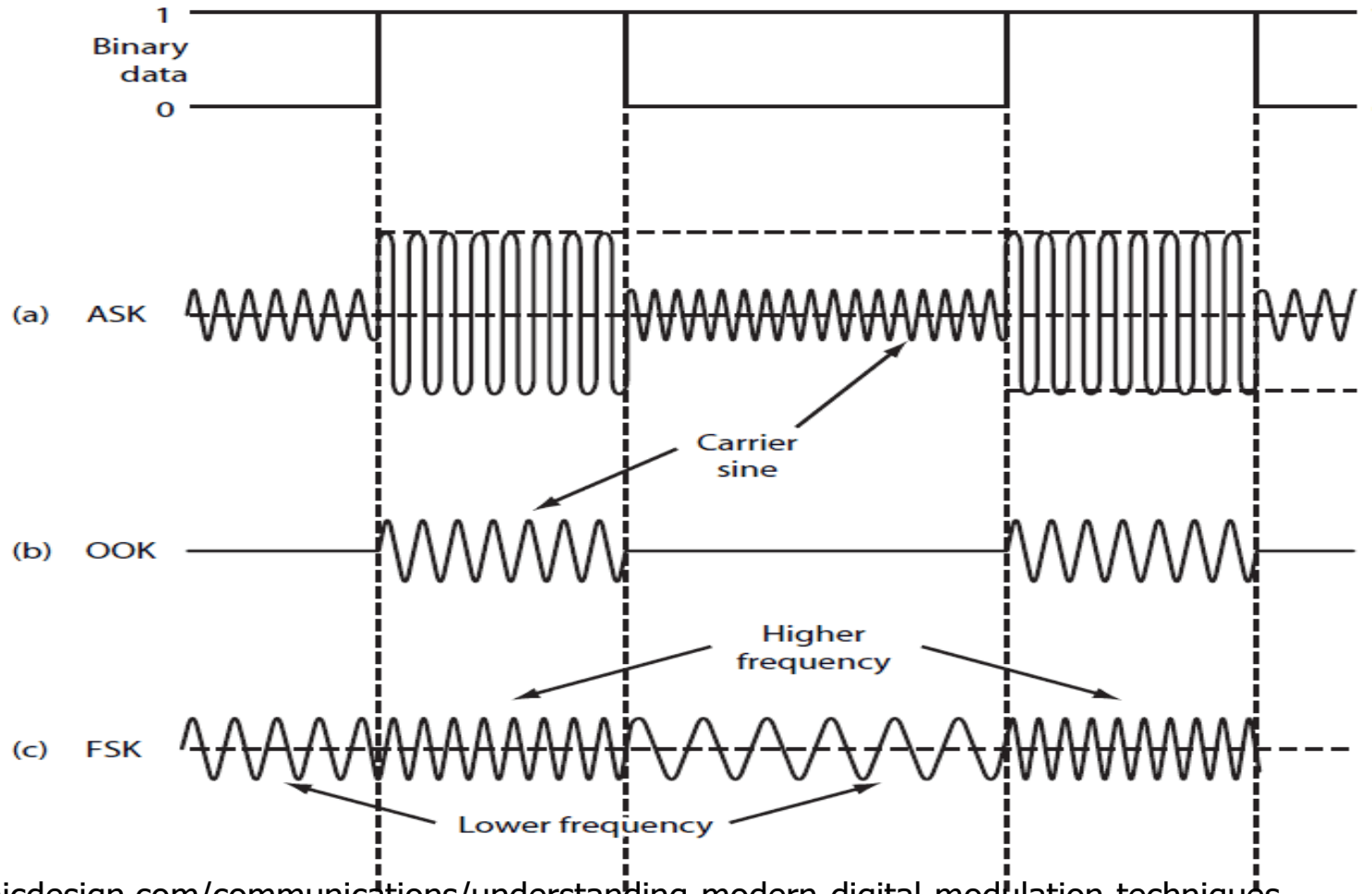


ARRL Amateur Radio Handbook, ©2005

Digital Modulation Methods

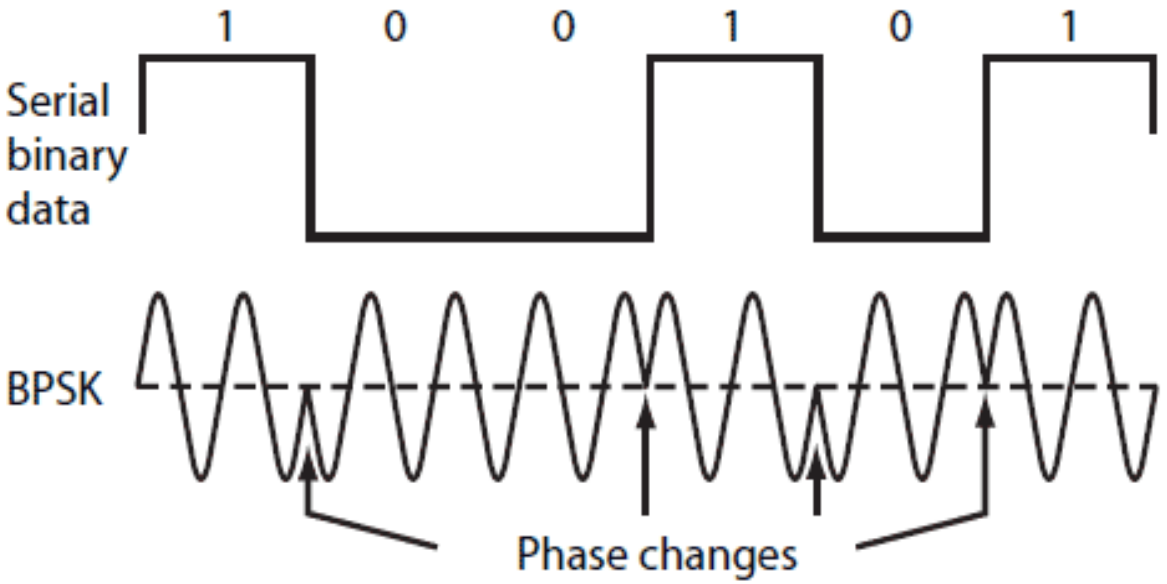
- Digital data is in two states, 1 is “On” and 0 is “Off”
- When Modulating this data onto a carrier, we can either;
  - Change the Amplitude
  - Change the Frequency
  - Change the Phase
    - Some form of phase modulation is more efficient as the data rate rises.

Digital Modulation Methods



http://electronicdesign.com/communications/understanding-modern-digital-modulation-techniques

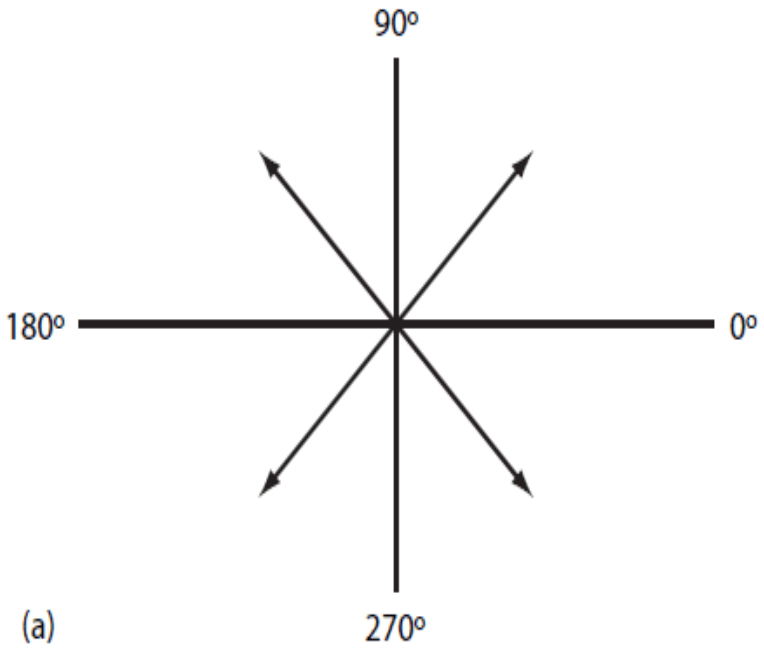
Digital Modulation Methods

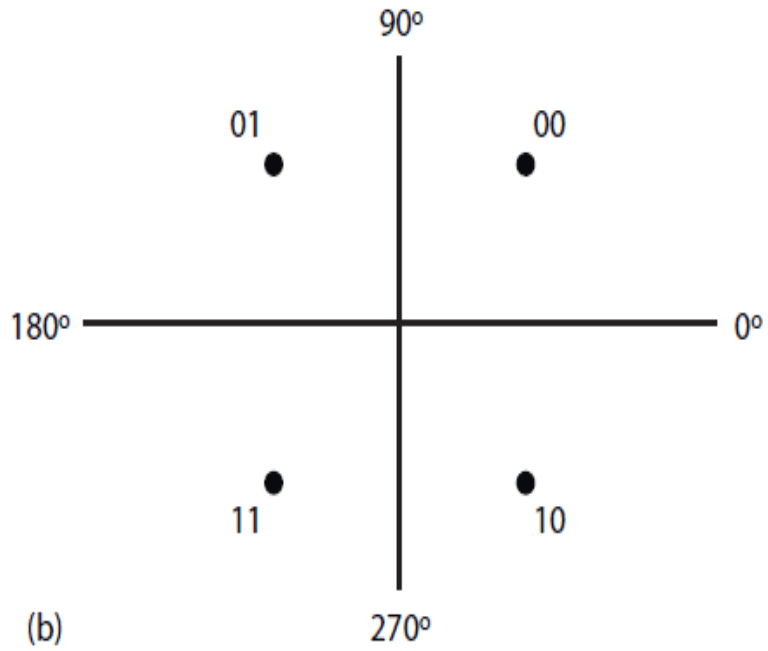


2. In binary phase shift keying, note how a binary 0 is 0° while a binary 1 is 180°. The phase changes when the binary state switches so the signal is coherent.

http://electronicdesign.com/communications/understanding-modern-digital-modulation-techniques

Digital Modulation Methods



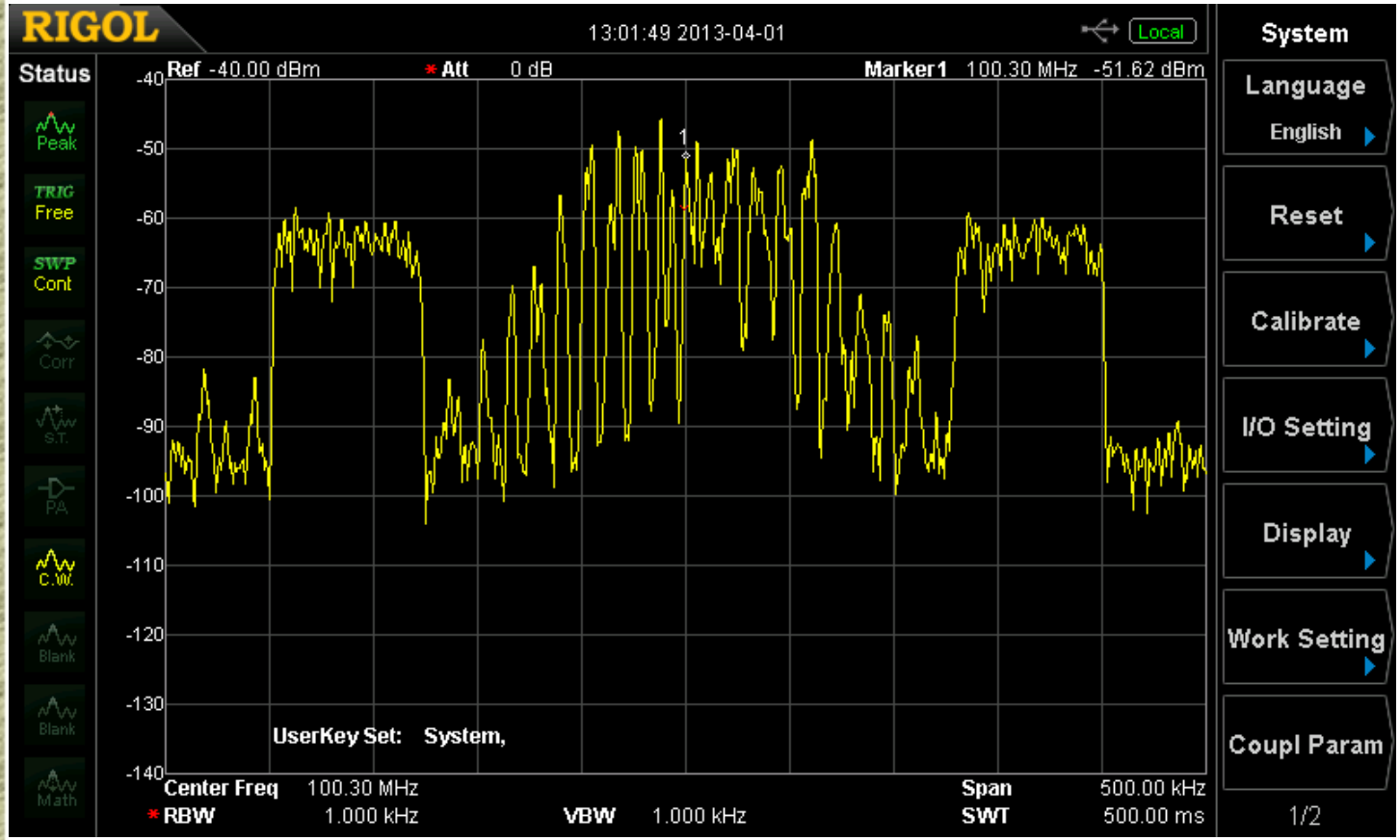


3. Modulation can be represented without time domain waveforms. For example, QPSK can be represented with a phasor diagram (a) or a constellation diagram (b), both of which indicate phase and amplitude magnitudes.

http://electronicdesign.com/communications/understanding-modern-digital-modulation-techniques

Digital Modulation Methods

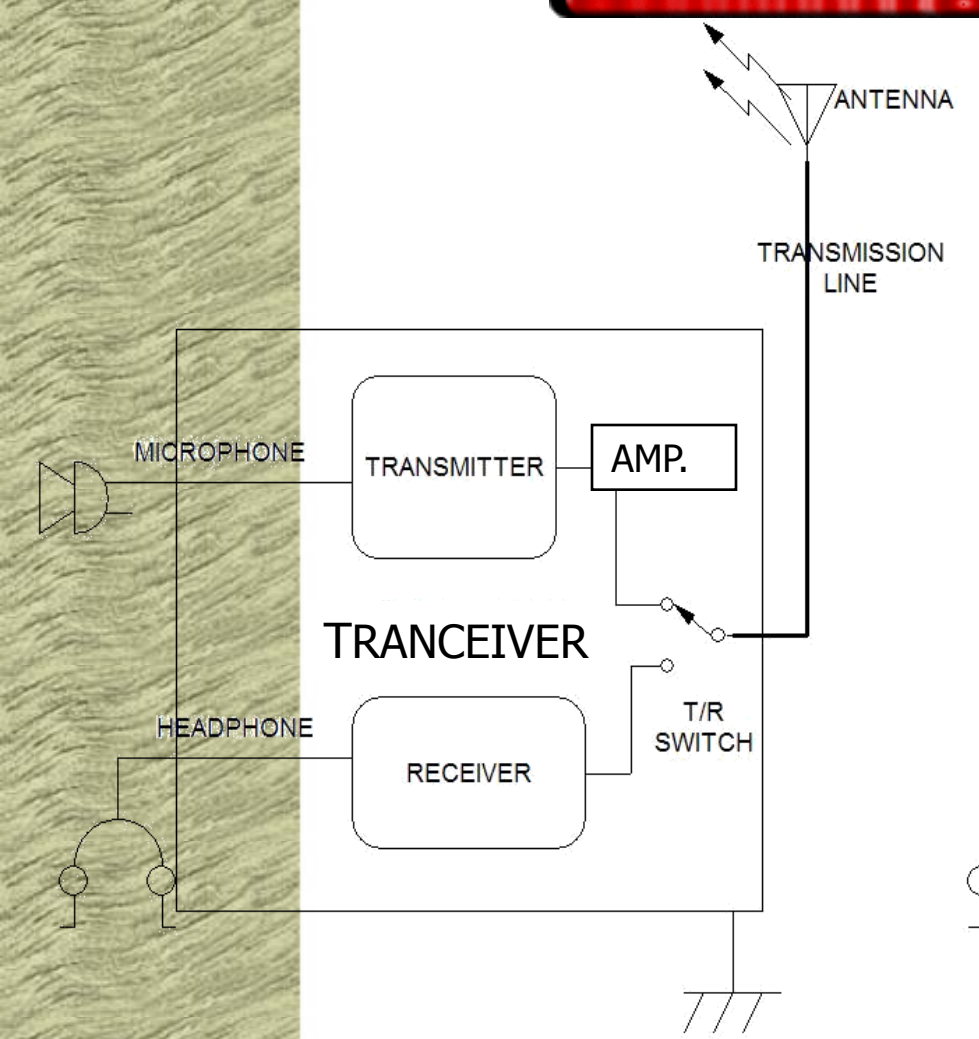
- "HD Radio" is a hybrid analog/digital modulation scheme.

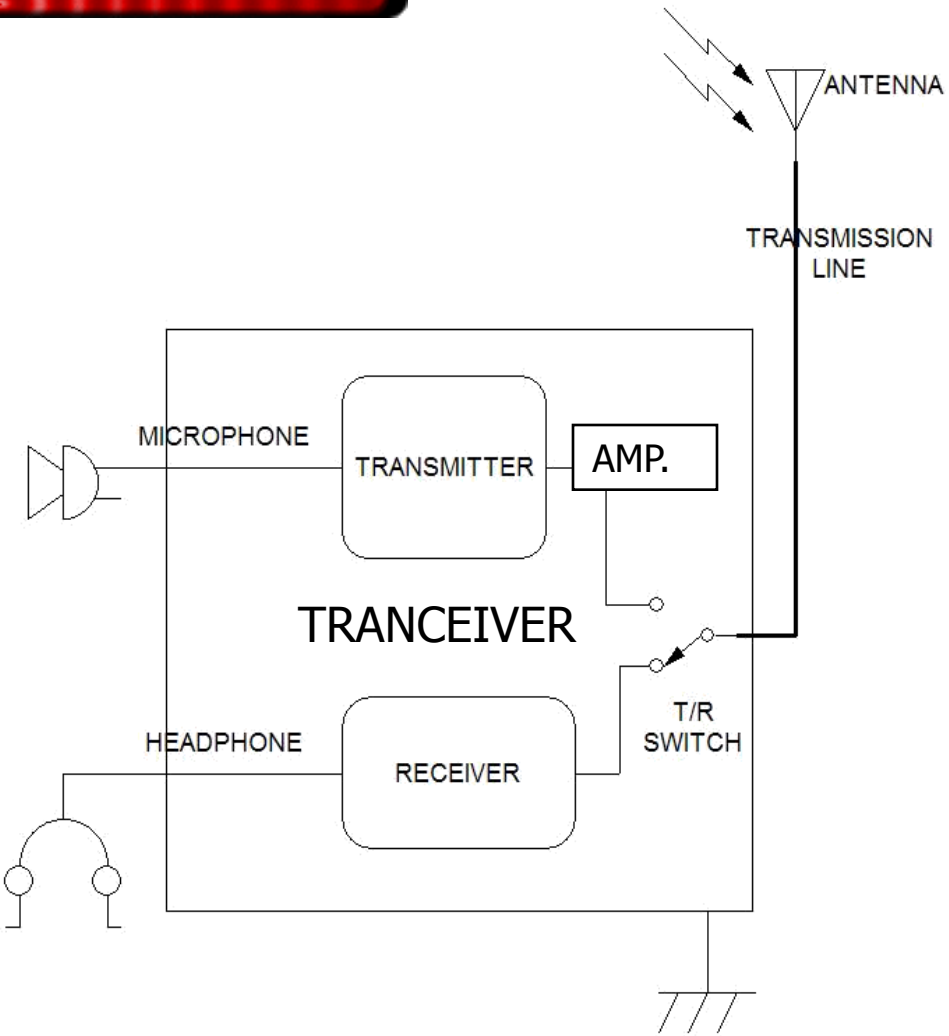


Radio Merit Badge Requirements

- 5. Do the following:
  - a. Explain the differences between a block diagram and a schematic diagram.
  - b. Draw a block diagram that includes a transceiver, amplifier, microphone, antenna, and feed line.
  - c. Discuss how information is sent when using Amplitude Modulation (AM), Frequency Modulation (FM), Continuous Wave (CW), Single Sideband (SSB) and Digital transmission.
  - d. Explain how NOAA Weather Radio can alert you to danger.

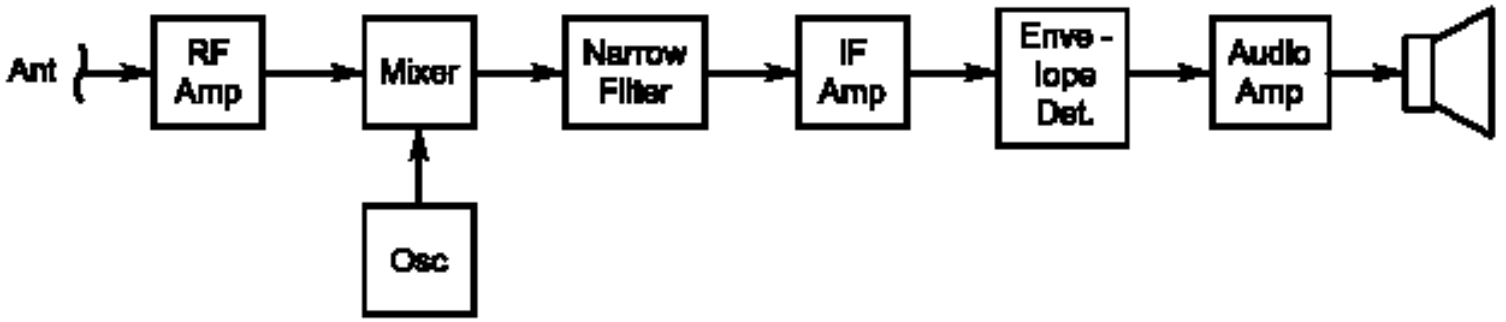
A Simple radio system



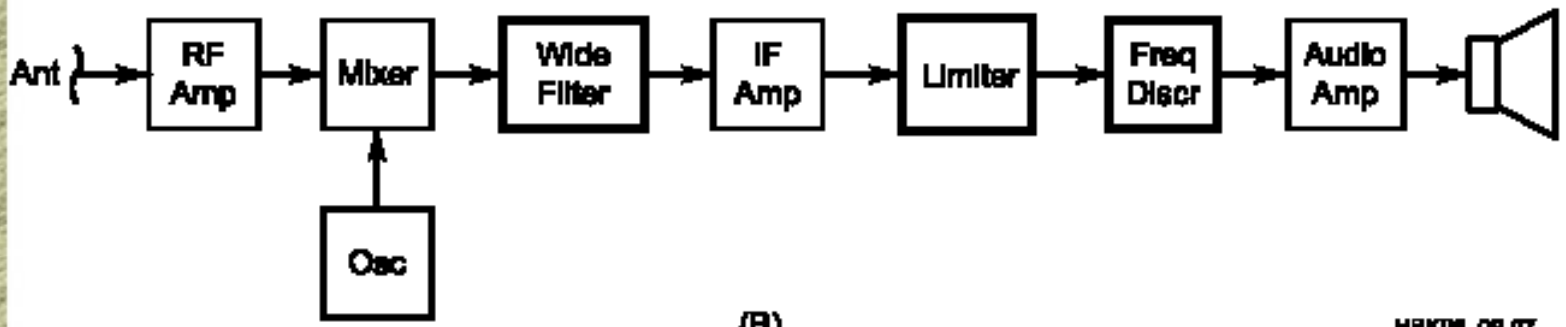


Radio Merit Badge

Block Diagrams of AM and FM Receiver



(A)



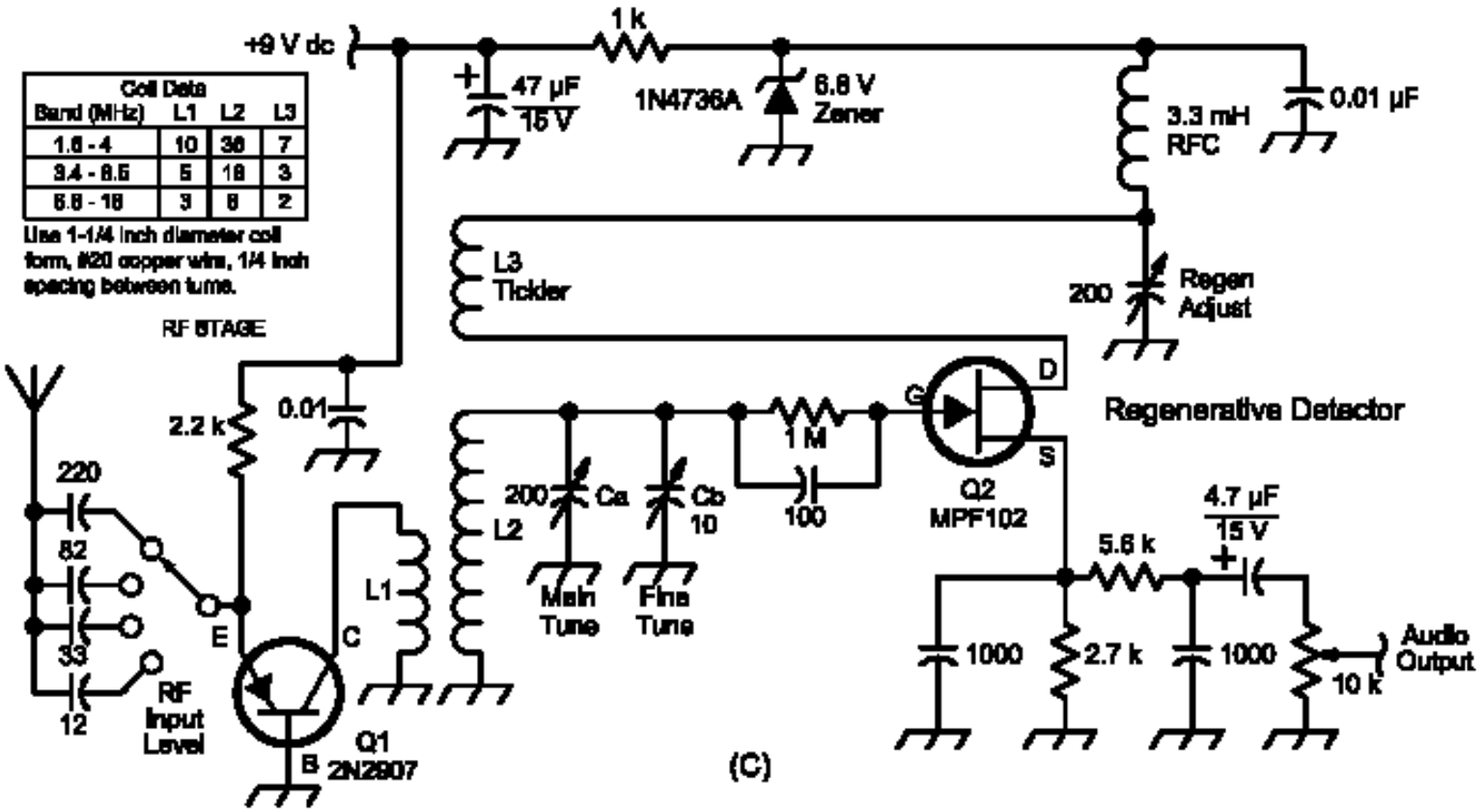
(B)

HBKDS_09-07

ARRL Amateur Radio Handbook, ©2005

Radio Merit Badge

Simple Schematic diagram of a Receiver.



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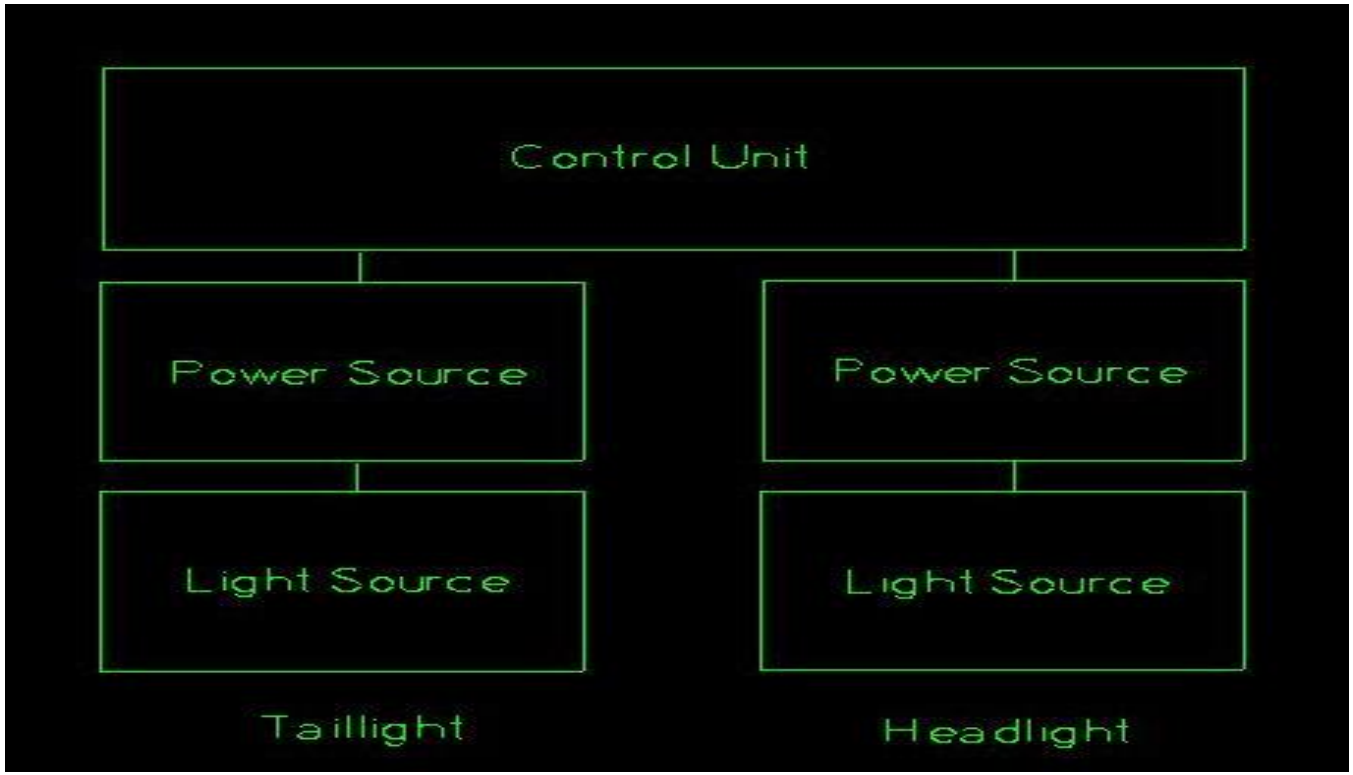
Block Diagrams

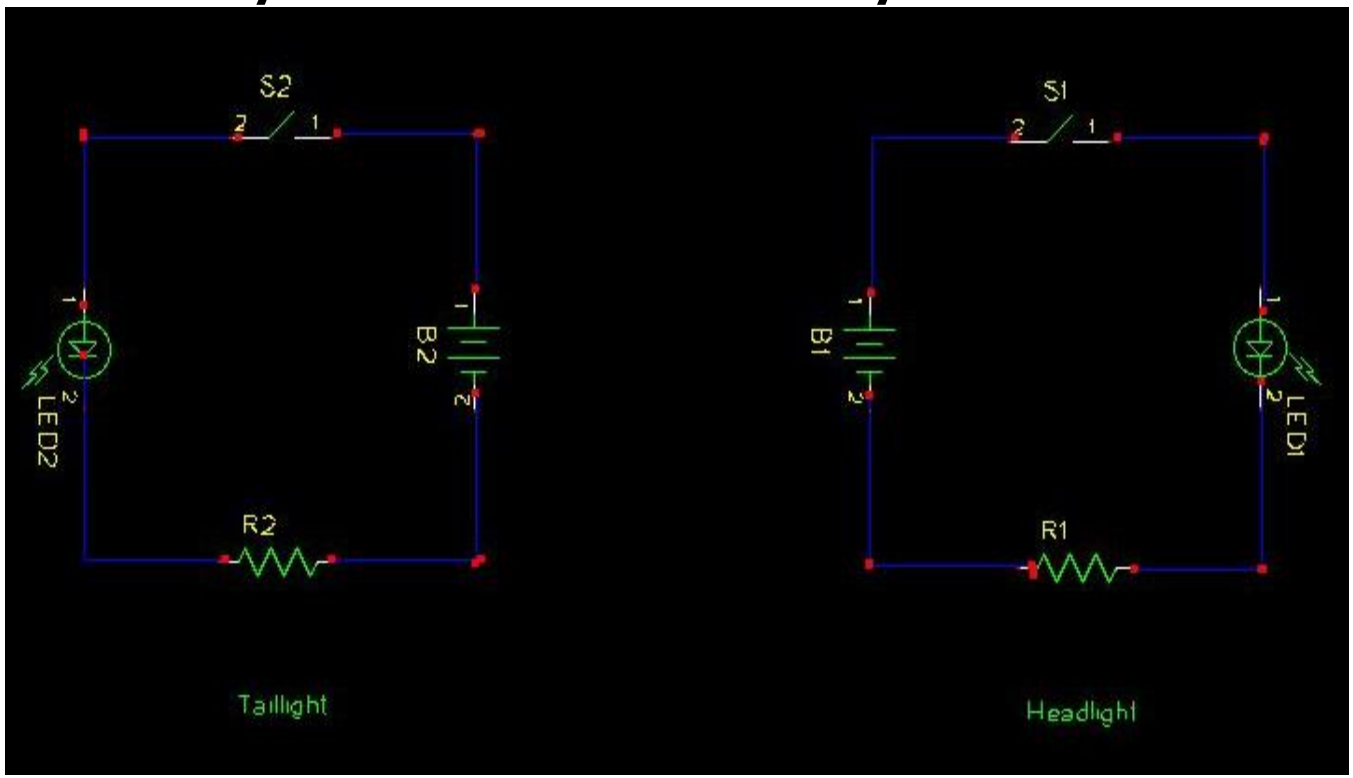
- Represent basic elements of a circuit or system.



http://en.wikipedia.org/wiki/Block_diagram

Schematic Diagrams

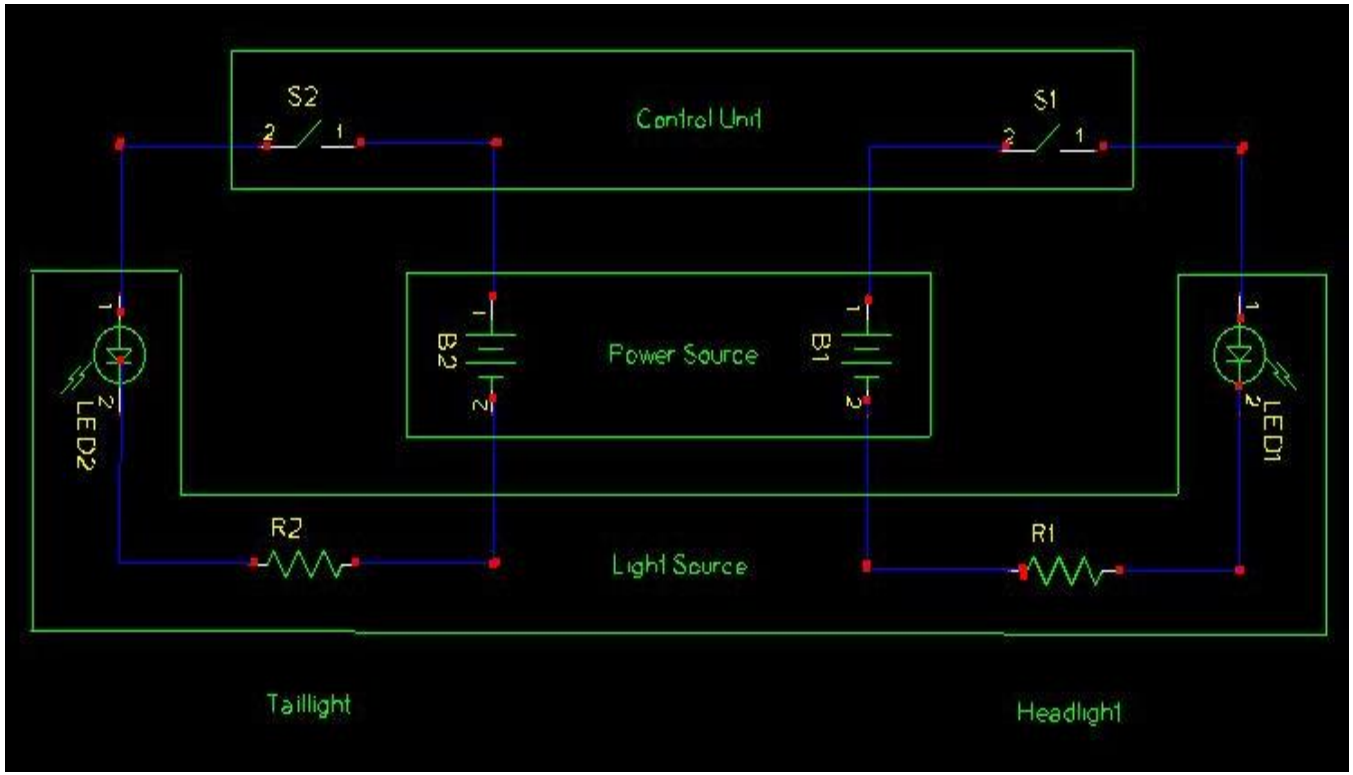
- Depict each specific component in a circuit. They use standard symbols.



http://en.wikipedia.org/wiki/Block_diagram

Schematic vs. Block Diagrams

- Many times a complex circuit diagram will have sections blocked for easy identification.



http://en.wikipedia.org/wiki/Block_diagram

Radio Merit Badge Requirements

- 5. Do the following:
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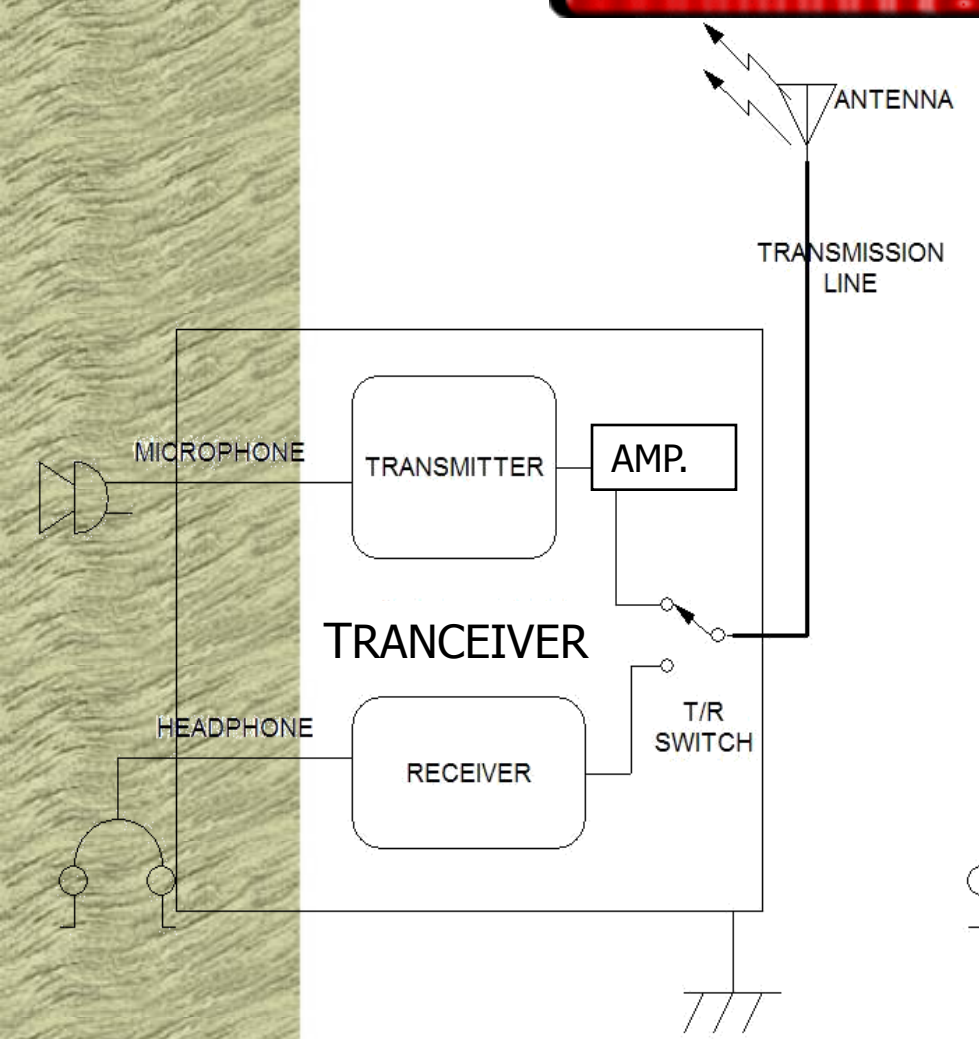
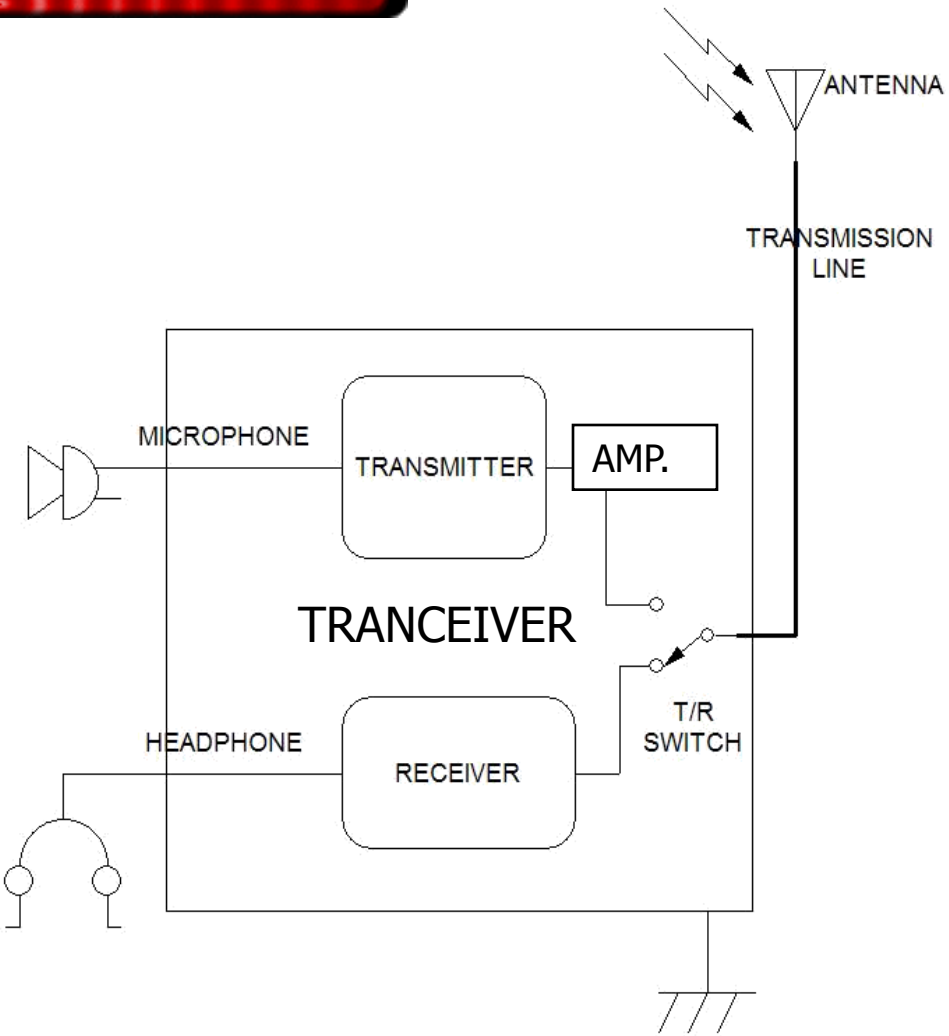
  - c. Discuss how information is sent when using Amplitude Modulation (AM), Frequency Modulation (FM), Continuous Wave (CW), Single Sideband (SSB) and Digital transmission.
  - d. Explain how NOAA Weather Radio can alert you to danger.

A Simple radio system





Radio Merit Badge Requirements

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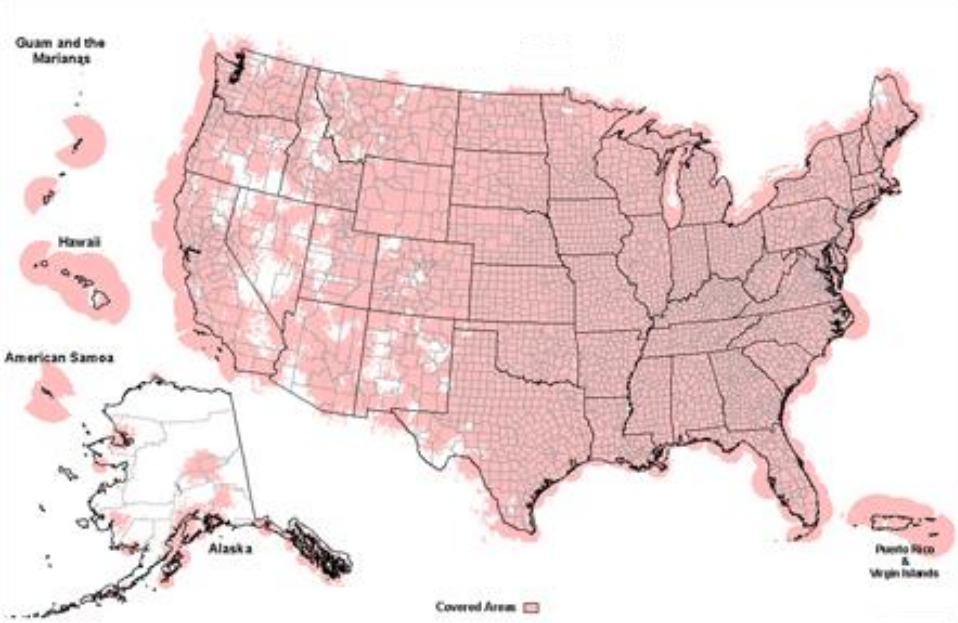
  - c. Discuss how information is sent when using Amplitude Modulation (AM), Frequency Modulation (FM), Continuous Wave (CW), Single Sideband (SSB) and Digital transmission.
  - D. Explain how NOAA Weather Radio can alert you to danger.

NOAA Weather Radio

- **National Oceanic** and **Atmospheric Administration** radio stations transmits weather and emergency information from 1025 transmitters using seven VHF frequencies from 162.400 MHz to 162.550 MHz.
- Alerts are transmitted for specific weather and emergency events covering specific areas.
- Specific Alert Message Encoding allows you to specify the particular area for which you wish to receive alerts.
- Weather radios should be part of any Scouting event especially campouts

NOAA Weather Radio

- **NOAA Radio can be heard almost everywhere in the USA**
- **No excuse to go anywhere without one.**



NOAA Weather Radio

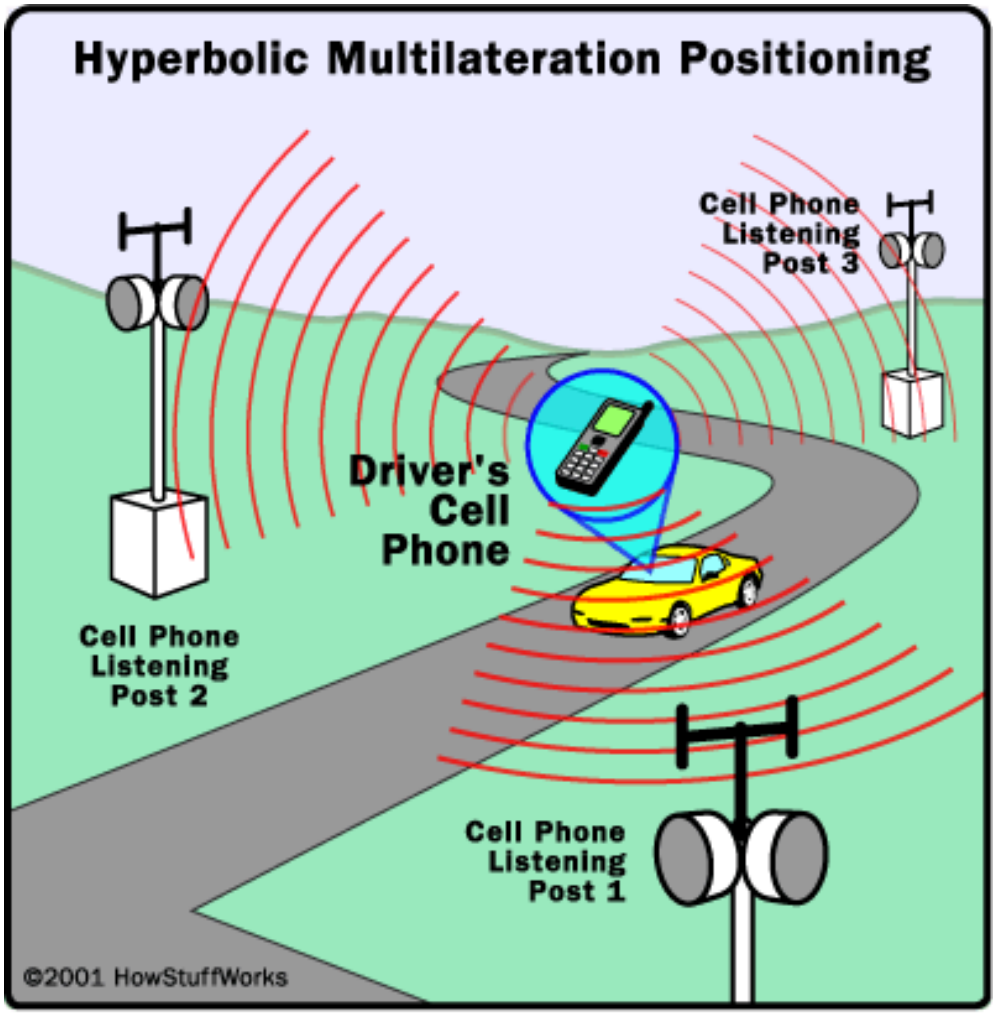
Radio Merit Badge

Skywarn spotter training

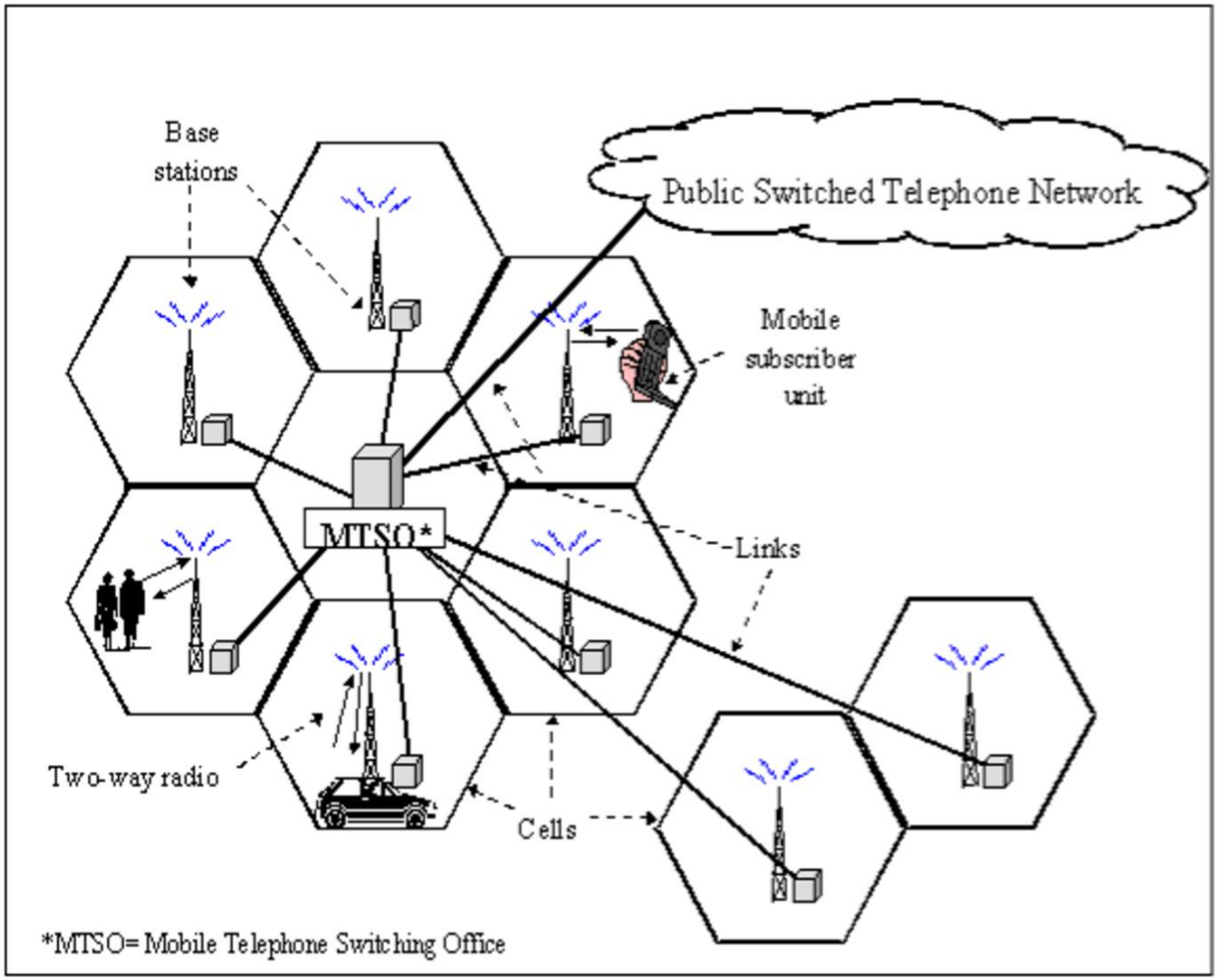
Radio Merit Badge Requirements

- 5. Do the following:
  - E. Explain how Cellular Telephones work. Identify their benefits and limitations in an emergency.

Cellular Telephone systems



Cellular Telephone systems



Cellular Telephone systems

- **Cellular Benefits**
- Cell systems reuse the same frequency.
- More frequency reuse allows more users and more data.
- A failure at one cell can be recovered by an adjacent cell.
- Allows freedom of movement.

Cellular Telephone systems

- **Cellular Limitations**
- Frequency reuse causes interference which needs to be controlled.
- Needs complex handover procedure when user moves from one cell to another.
- System requires complex infrastructure and may not survive a disaster.

Radio Merit Badge Requirements

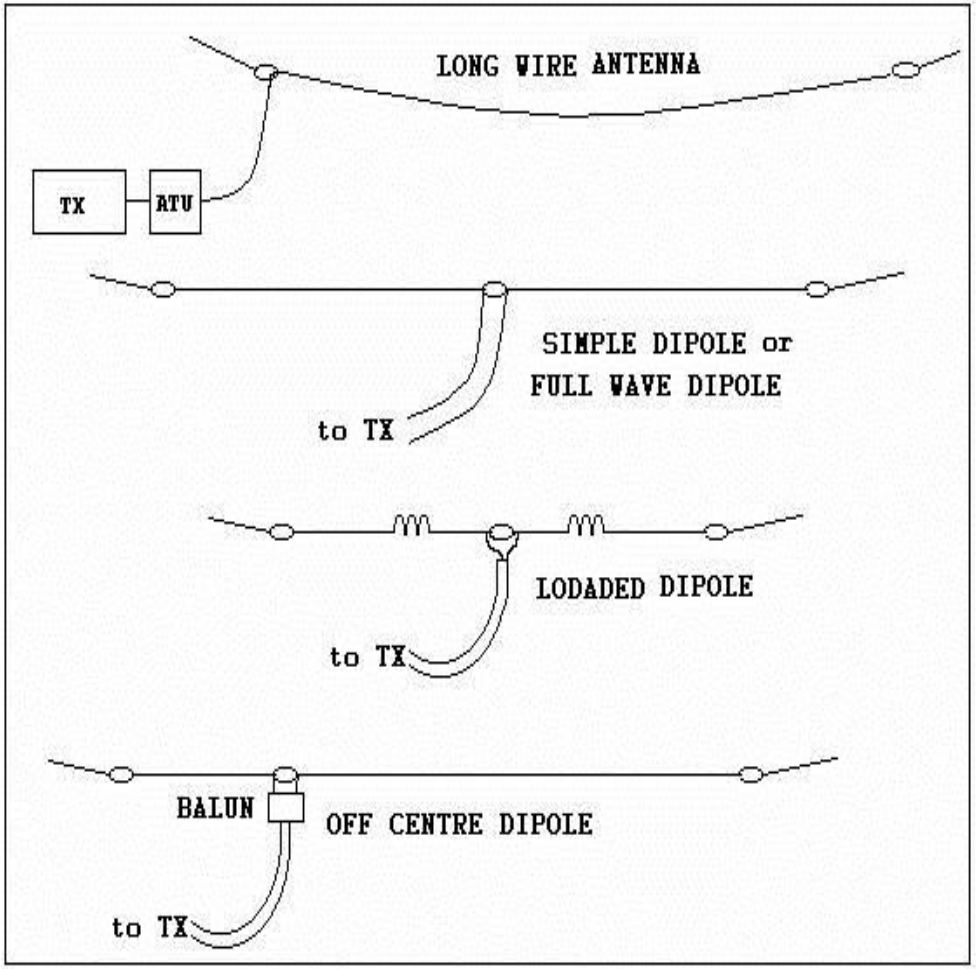
- 7. Visit a radio installation (an amateur radio station, broadcast station, or public communications center, for example) approved in advance by your counselor. Discuss what types of equipment you saw in use, how it was used, what types of licenses are required to operate and maintain the equipment, and the purpose of the station

Amateur Radio Station.

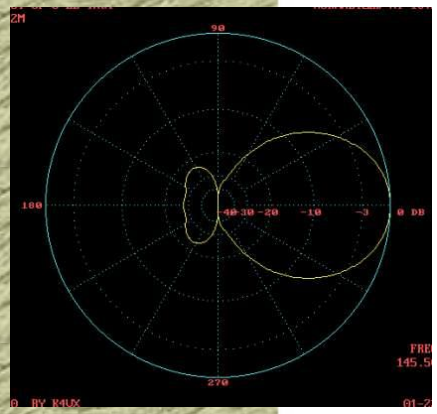
- What you will see at a typical amateur station will vary with the interests, budget and location of the operator.
- Equipment can cost from a few dollars to thousands.
- Installations can be simple or highly complex.

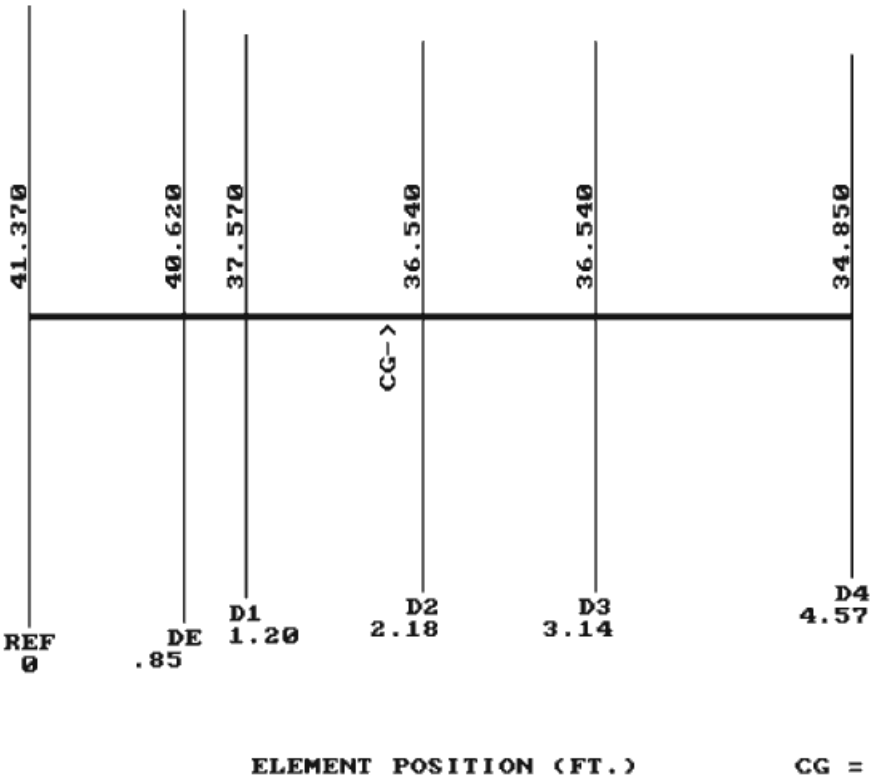
Amateur Radio Station.

- Wire antennas are inexpensive and can be used in many different types of locations.



Amateur Radio Station.

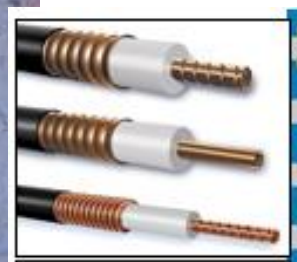




- Beam or Yagi antennas allow for more gain in a particular direction. Since the elements get smaller at higher frequencies, they are easier to build with more gain.

Amateur Radio Station.

- Transmission (Feed) Line may be either **coaxial** or **open wire**.



Amateur Radio Station.

- Stations range from simple to elaborate.

Radio Merit Badge Requirements

- 9a. *Amateur radio*
  - 1. Tell why the FCC has an amateur radio service. Describe some of the activities that amateur radio operators can do on the air, once they have earned an amateur radio license.
  - 2. Explain some of the differences between the Technician, General, and Extra Class license requirements and privileges. Explain who administers amateur radio exams.
  - 3. Explain at least five Q signals or amateur radio terms you hear while listening.
  - 4. Explain how you would make an emergency call on voice or Morse code.
  - 5. Explain the differences between handheld transceivers and home "base" transceivers. Explain the uses of mobile amateur radio transceivers and amateur radio repeaters.
  - 6. Using proper call signs, Q signals, and abbreviations, carry on a 10 minute real or simulated radio contact using voice, Morse Code, or digital mode. (Licensed amateur radio operators may substitute five QSL cards as evidence of contacts with amateur radio operators from at least three different call districts.) Properly log the real or simulated ham radio contact and record the signal report.

Special symbols and abbreviations.

- **Q signals** are standard abbreviations to convey specific information or ask a question.
- Developed initially for CW (Morse Code) operation they also can be used on HF phone.
- Not generally used on repeaters.

http://www.qsl.net/w5www/qcode.html

Special symbols and abbreviations. Common Q signals

- **QRM -** Are you being interfered with? / I am being interfered with.
- **QRN** - Are you troubled by static?/ I am troubled by static.
- **QRO** - Must I increase power? / Increase power.
- **QRP** - Must I decrease power? / Decrease power.
- **QRQ** - Must I send faster? / Send faster ... (words per min.).

Special symbols and abbreviations. Common Q signals

- **QRS** - Must I send more slowly? / Transmit more slowly ... (w.p.m.).
- **QRT** - Must I stop transmission? / Stop transmission.
- **QRZ** - By whom am I being called? / You are being called by ...
- **QSB** - Does the strength of my signals vary? / The strength of your signals varies.
- **QSL** - Can you acknowledge receipt? / I am acknowledging receipt.

Special symbols and abbreviations. Common Q signals

- **QSO** - Can you communicate with ... directly (or through...)? / I can communicate with ... direct (or through...).
- **QSY** - Shall I change to ... Kilocycles? / Change to ... kc.
- **QTH** - What is your position (location)? / My position (location) is ....
- **QST** - General call preceding a message address to all amateurs and A.R.R.L. Members. This is in effect "CQ ARRL".
- **QRRR** - Official A.R.R.L. "land SOS." A distress call for emergency use only.

Radio Merit Badge

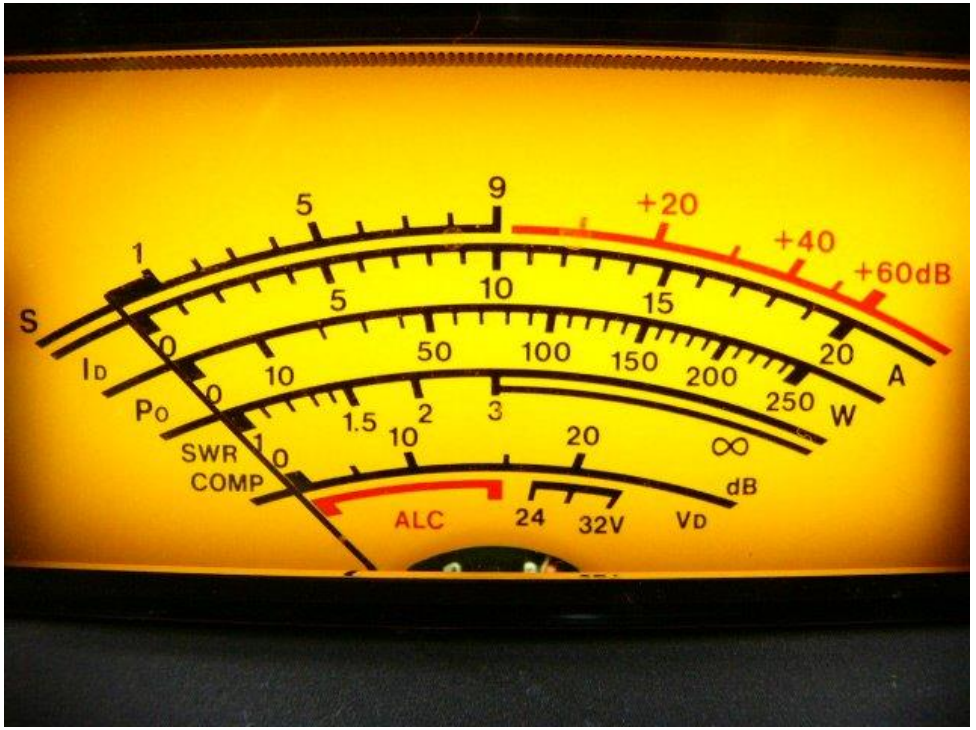
Special symbols and abbreviations.

- **CQ** is a code used by wireless operators to signify that a general call to any interested party to come back to the caller.
- May be followed by additional letters or phrases such as CQ Contest or CQ DX.
- **CQ CQ CQ de N5HYP N5HYP N5HYP CQ CQ CQ K (As sent in CW {Morse Code})**

Radio Merit Badge

Special symbols and abbreviations.

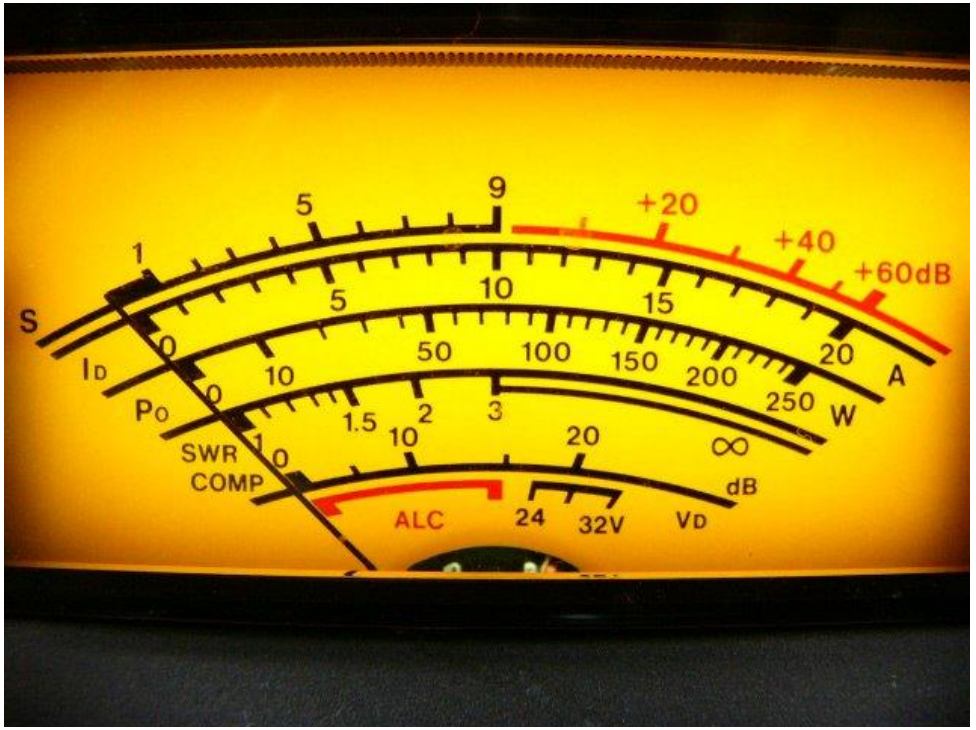
- **RST** is the abbreviation for "Signal Report".
- In Morse code, R stands for Readability (0-5).
- S stands for Signal strength as appears on the S-meter (0-9+).
- T stands for Tone quality (0-9 CW only).



Radio Merit Badge

Special symbols and abbreviations.

- In voice modes, the T is dropped.
- R and S tend to be somewhat subjective.
- Typical usage in voice modes – “your report 57 57”.
- Poorer conditions on voice – “Your signal report is 3 by 3, 3 by 3”.



Special symbols and abbreviations.

- **73** is a salutation that is used to signify the end of a QSO.
- Meaning "Best regards" it had it's beginnings in the earliest days of wired telegraphy.
- Usage "Will hope to here you on the bands again. 73 and God bless. K7WAV this is N5HYP.

Special symbols and abbreviations.

- The call sign you receive from the FCC when you get licensed is your unique identifier throughout the world.
- By regulation; must be given at the beginning and end of each conversation.
- Must also be given at least every 10 minutes during a conversation.
- Since this is two way communications, it is also good to give the other station's call as well (Roger KE7UA this is N5HYP).

Radio Merit Badge

Special symbols and abbreviations.

- What is the call sign we get to use on the air today?

K2BSA/5

- What are the phonetics we will use for this call sign?

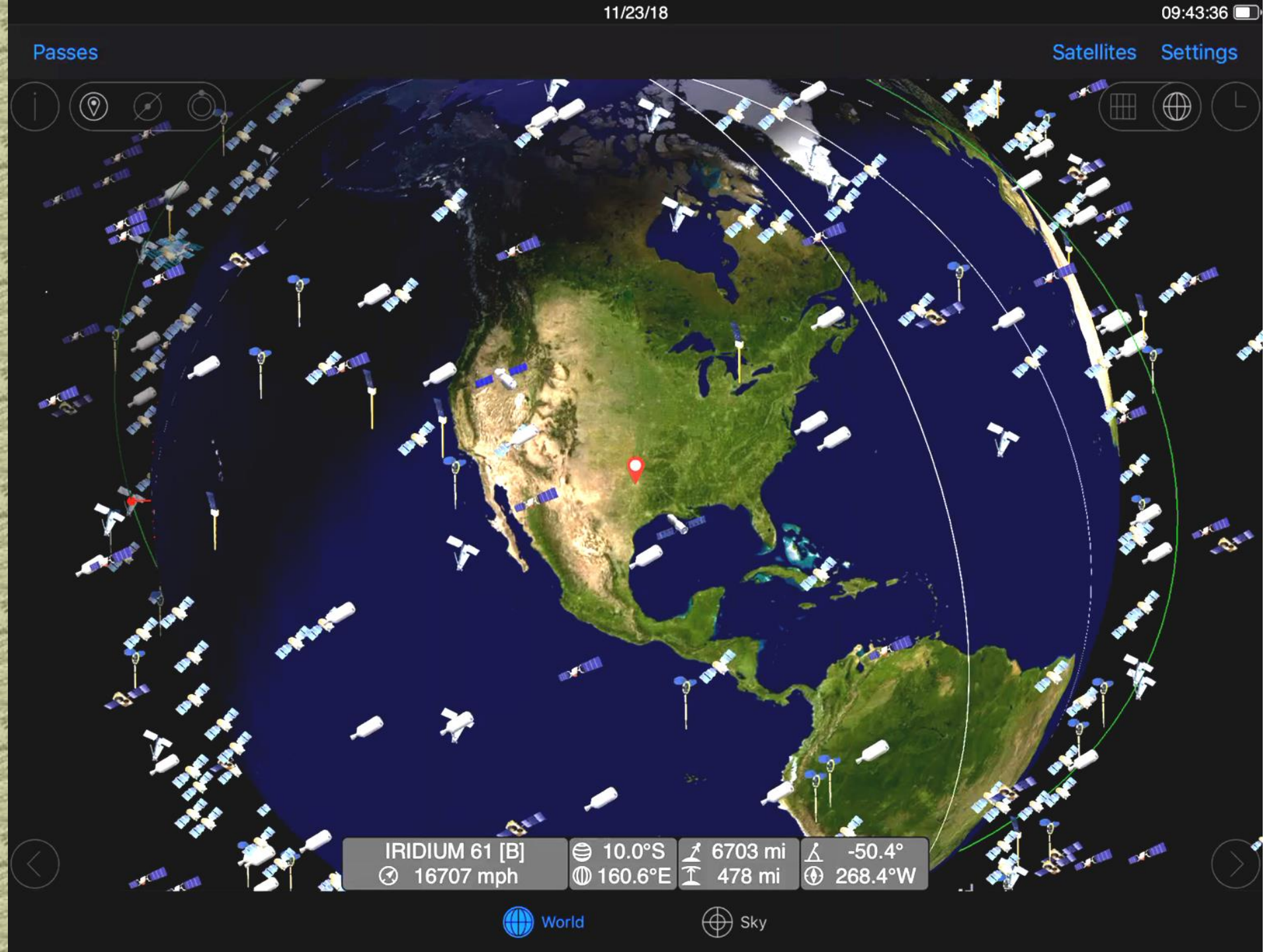
Kilo 2 Bravo Sierra Alpha stroke 5

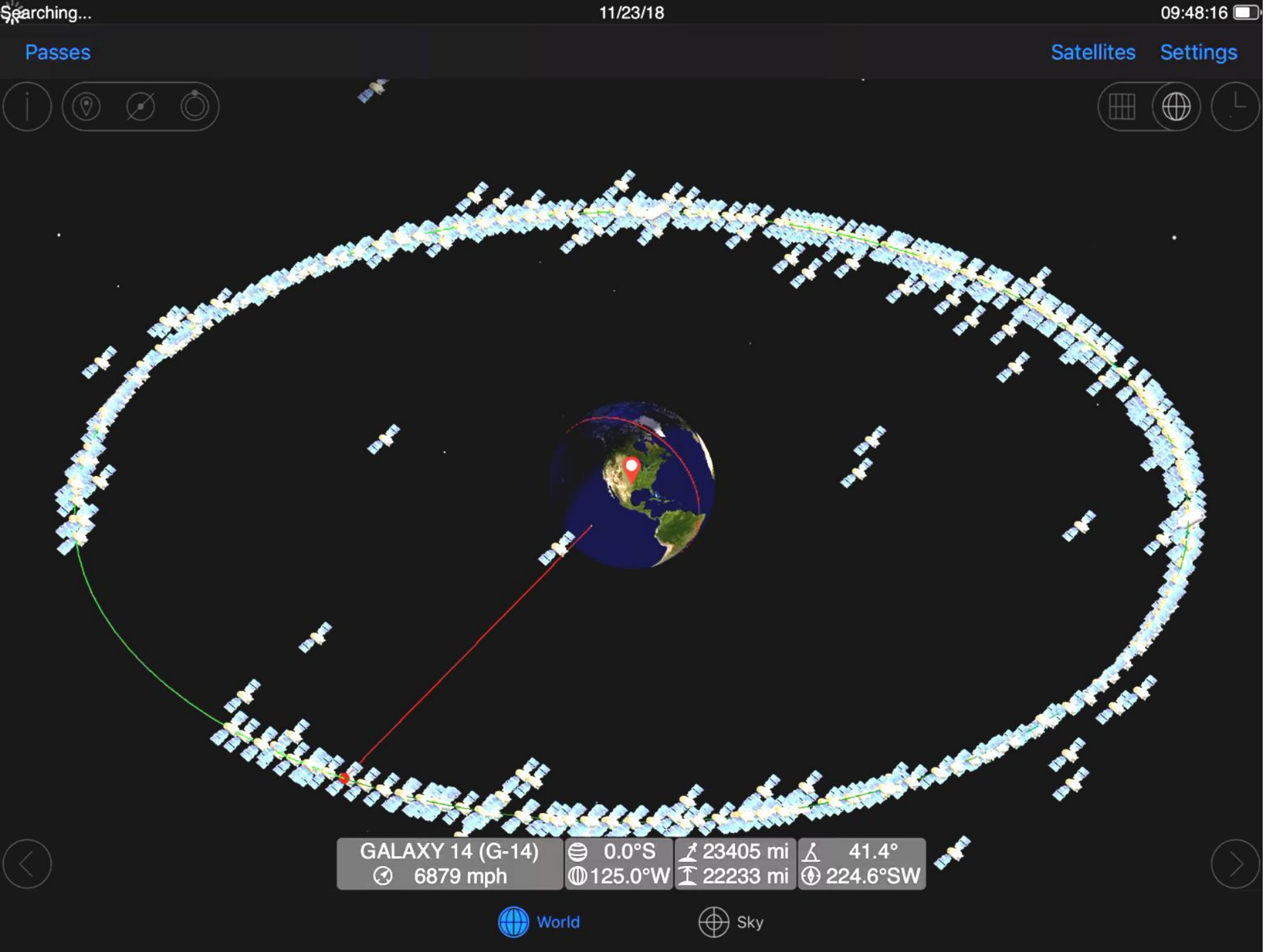
Radio Merit Badge

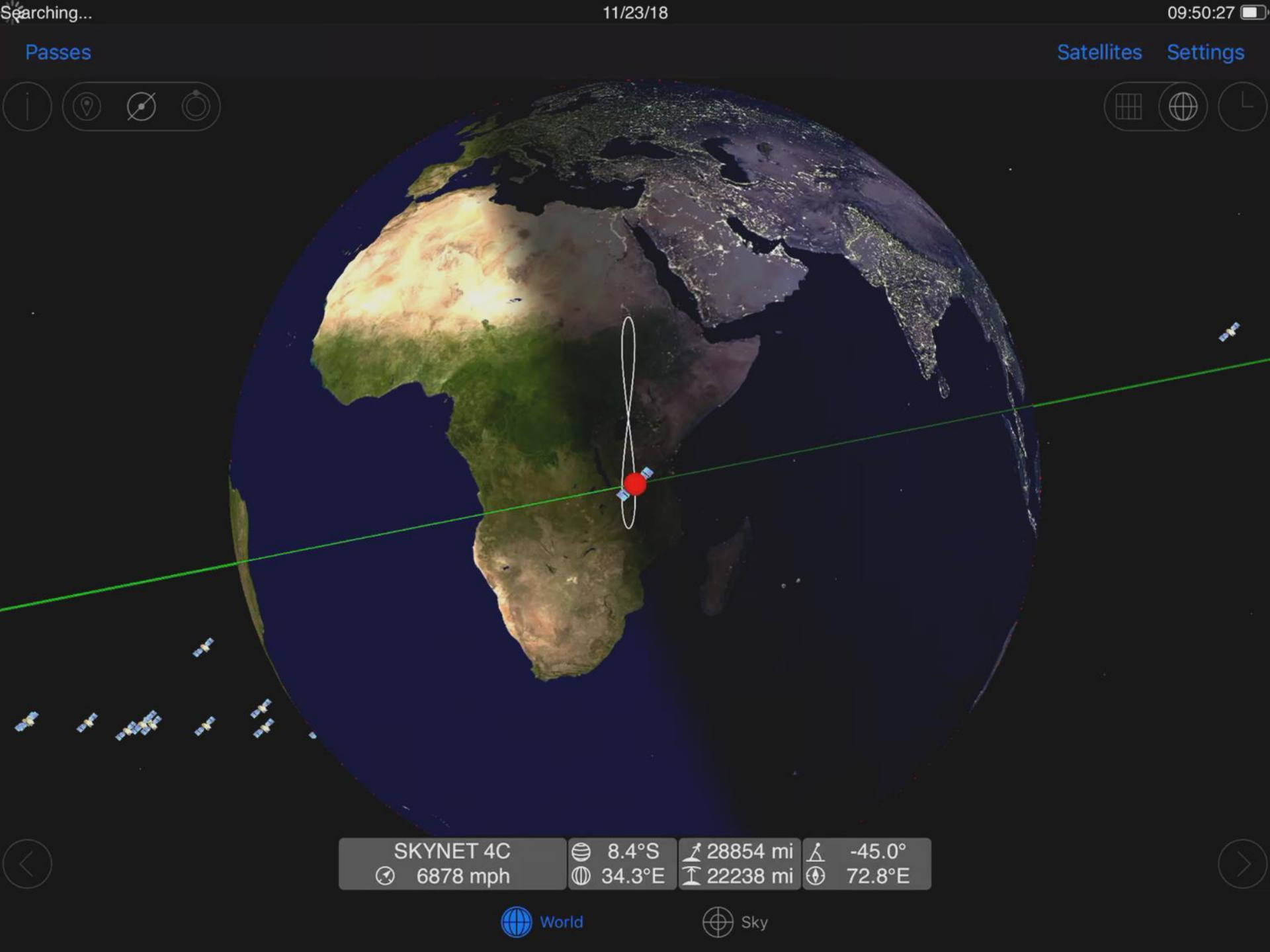
Amateur Radio Satellite Communications

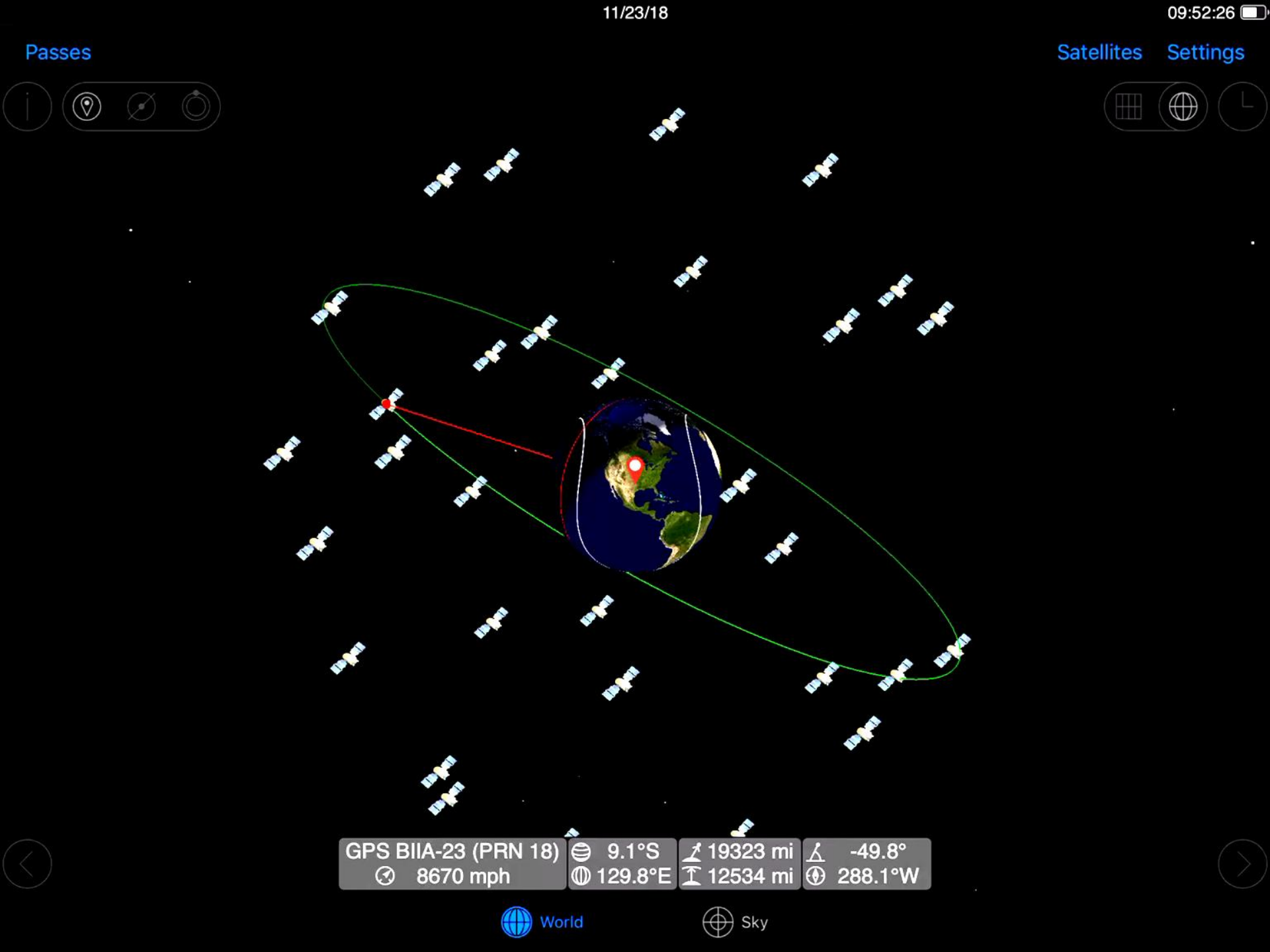
Amateur Radio Satellite Ops.

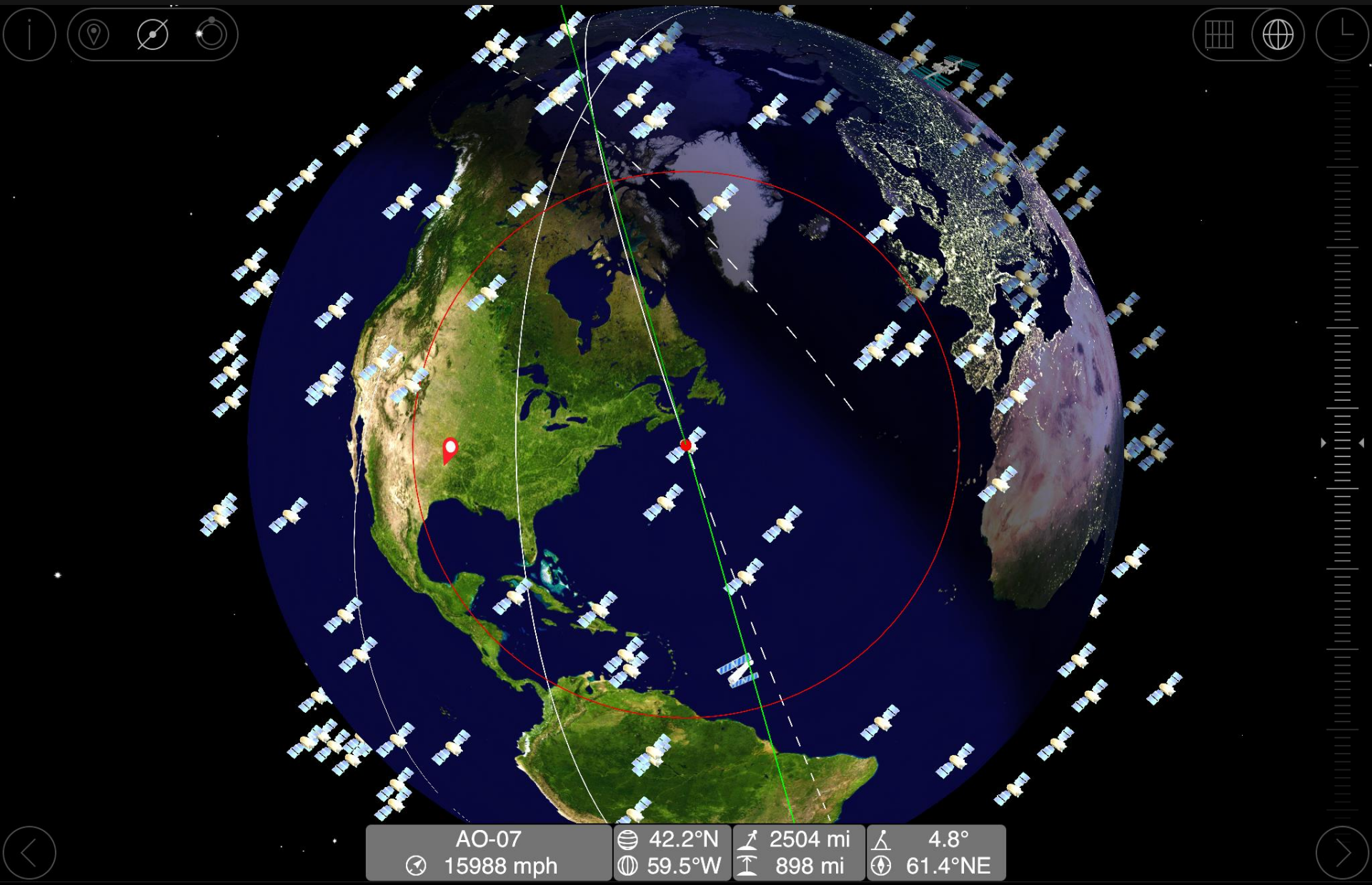
- Amateur Radio operators have been involved with Satellites since earliest days of Space Exploration.
- Groups from the US, Russia, China, France, Lithuania, Germany, Argentina, Brazil, have built payloads that use Amateur Radio frequencies.
- This Afternoon, we will attempt to communicate through a satellite produced in here in the U.S.A. by AMSAT-NA.
- **Fox 1B** is also known as **AO-91**.


11/23/18
09:43:36
Passes
Satellites
Settings
IRIDIUM 61 [B]
16707 mph
10.0°S
160.6°E
6703 mi
478 mi
-50.4°
268.4°W
World
Sky


Searching...
11/23/18
09:48:16
Passes
Satellites
Settings
GALAXY 14 (G-14)
6879 mph
0.0°S
125.0°W
23405 mi
22233 mi
41.4°
224.6°SW
World
Sky


Searching...
11/23/18
09:50:27
Passes
Satellites
Settings
SKYNET 4C
6878 mph
8.4°S
34.3°E
28854 mi
22238 mi
-45.0°
72.8°E
World
Sky

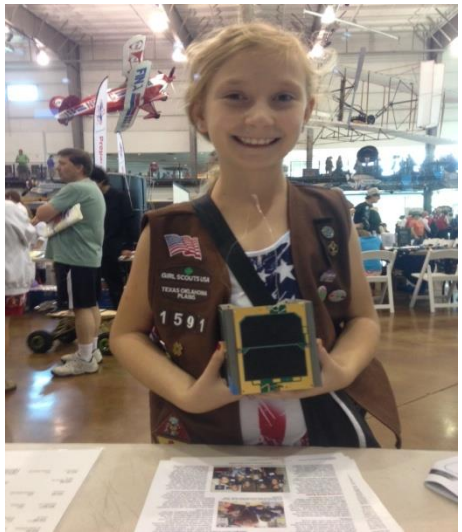

11/23/18
09:52:26
Passes
Satellites
Settings
GPS BIIA-23 (PRN 18)
8670 mph
9.1°S
129.8°E
19323 mi
12534 mi
-49.8°
288.1°W
World
Sky

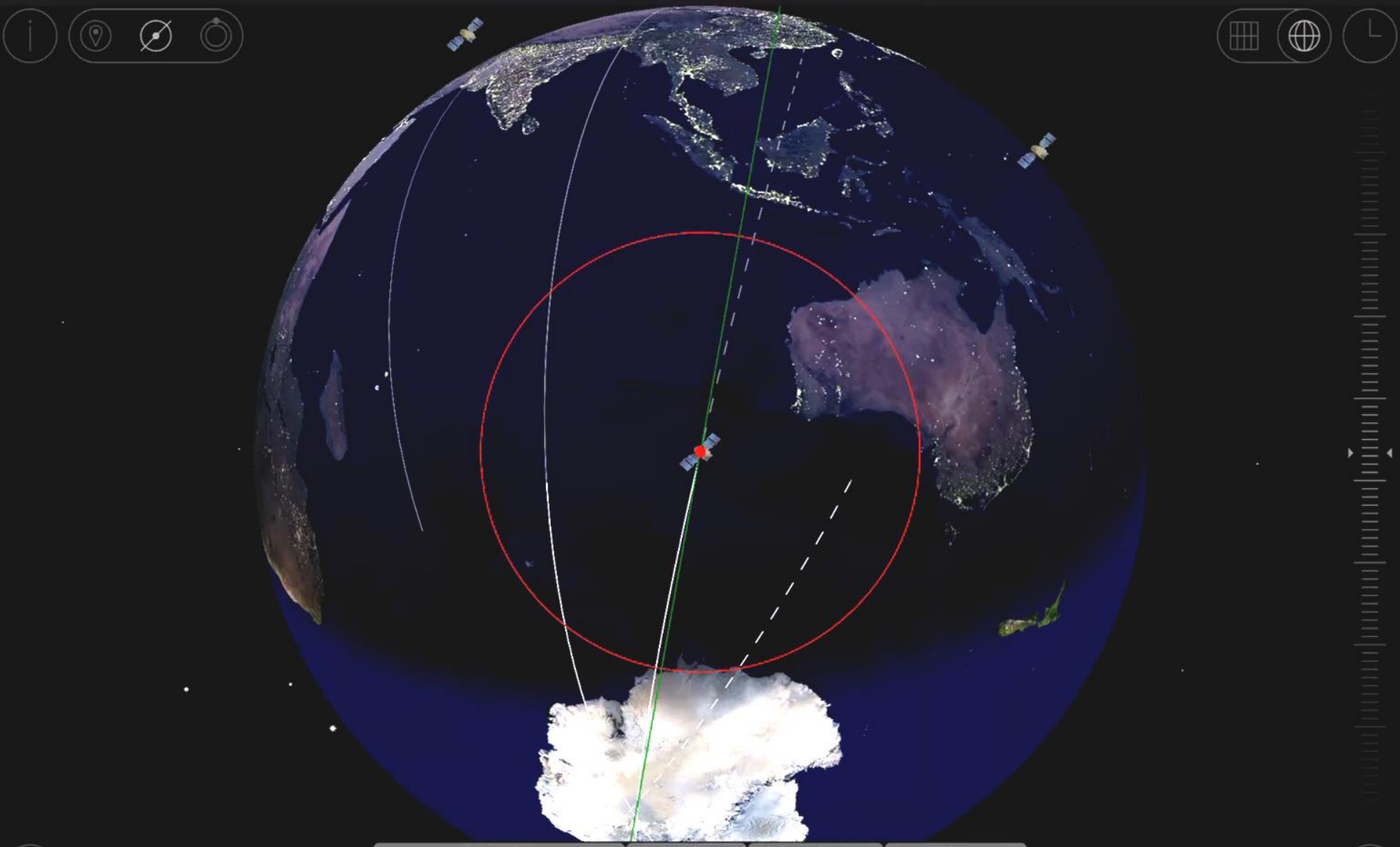

AO-07
15988 mph
42.2°N
59.5°W
2504 mi
898 mi
4.8°
61.4°NE

ISS	26.5°N	1072 mi	6.1°
17166 mph	81.7°W	251 mi	111.4°E

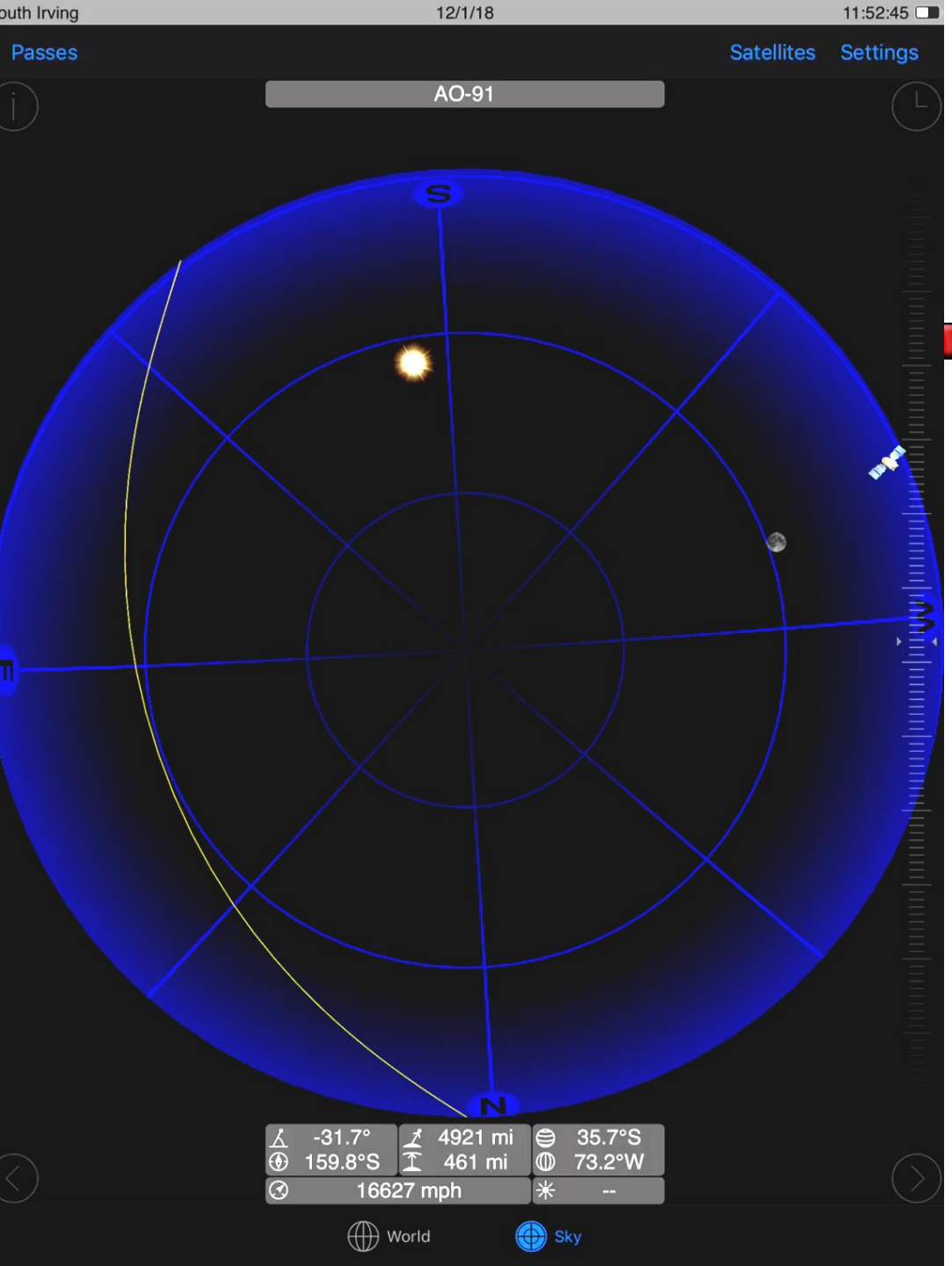
AMSAT-NA Fox Satellites

- AMSAT North America is working to launch the last 2 of 5 new satellites in the next year. Fox 1B is second.
- Known as cubesats, are 10x10x10 Cm in size
- Amateur Radio communications and experiments from several US universities.





AO-91	40.1°S	8307 mi	-81.1°
16549 mph	102.1°E	482 mi	239.9°SW



Ascending pass coming from south to north.

AOS at 145° at 12:06

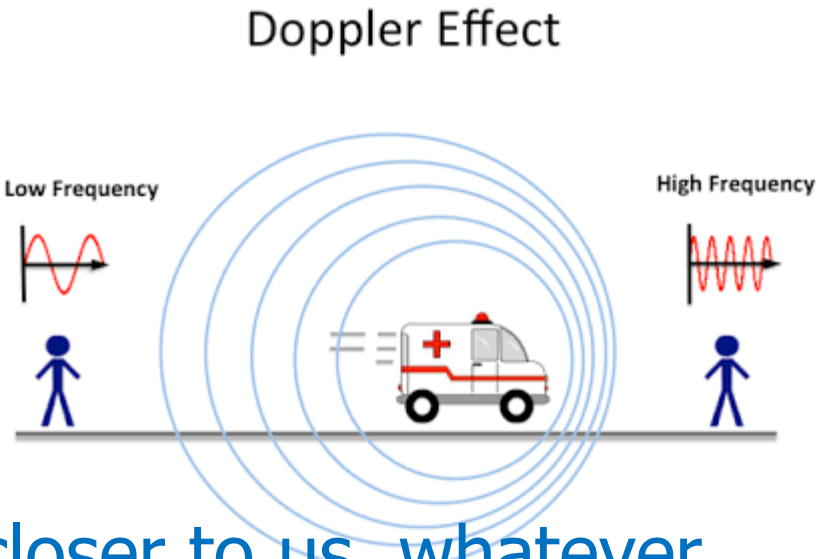
Maximum elevation about 29° at about 78° 12:11:45

LOS at 2° at 12:17:04

Total pass time 11 minutes. We will probably get 7.

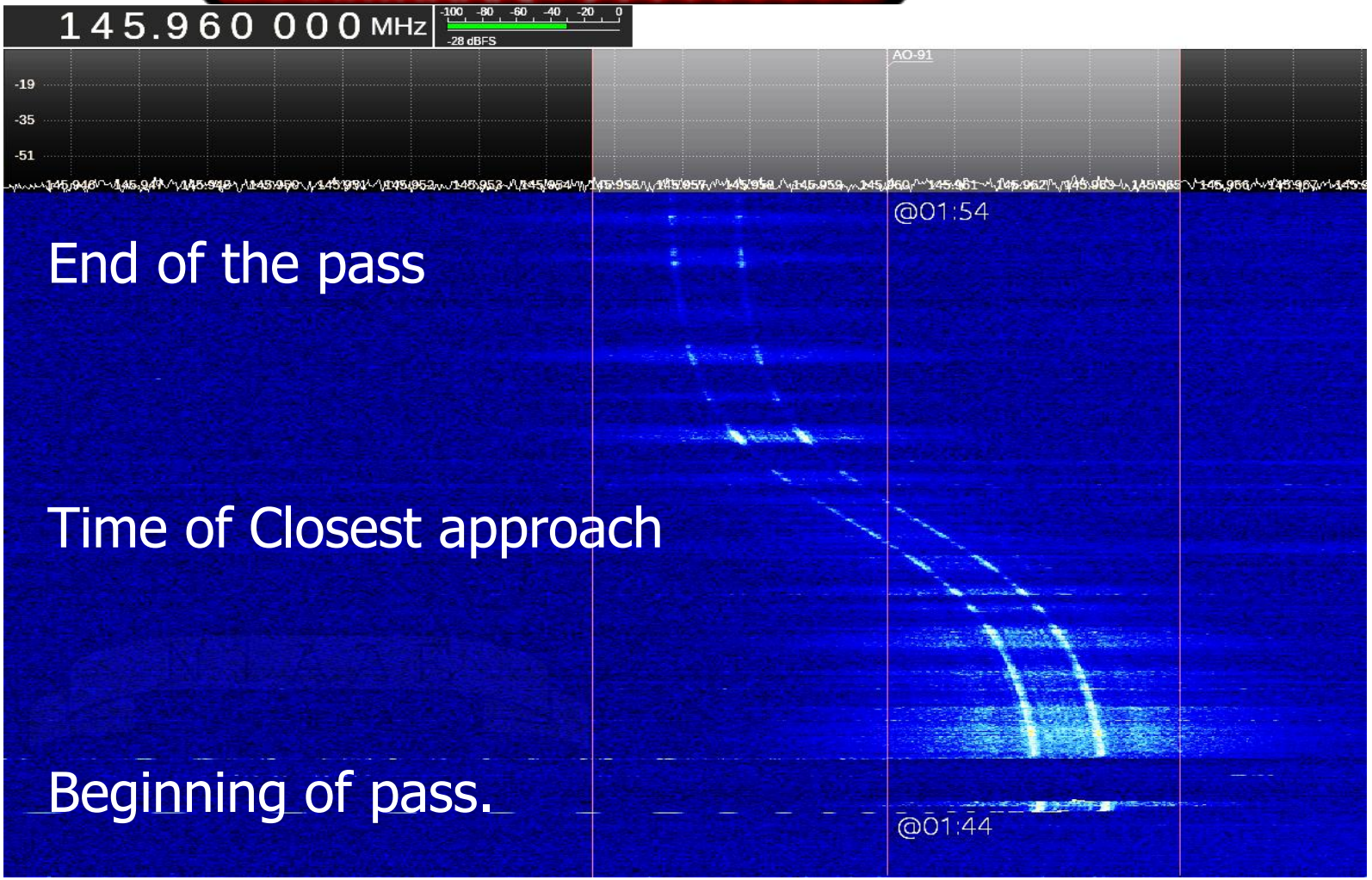
Amateur Radio Satellite Ops.

- Doppler effect
- Affects sounds
- Affects radio signals
- Affects light



- As an object comes closer to us, whatever frequency of emission it is putting out will appear higher.
- As it goes away, it will appear lower.

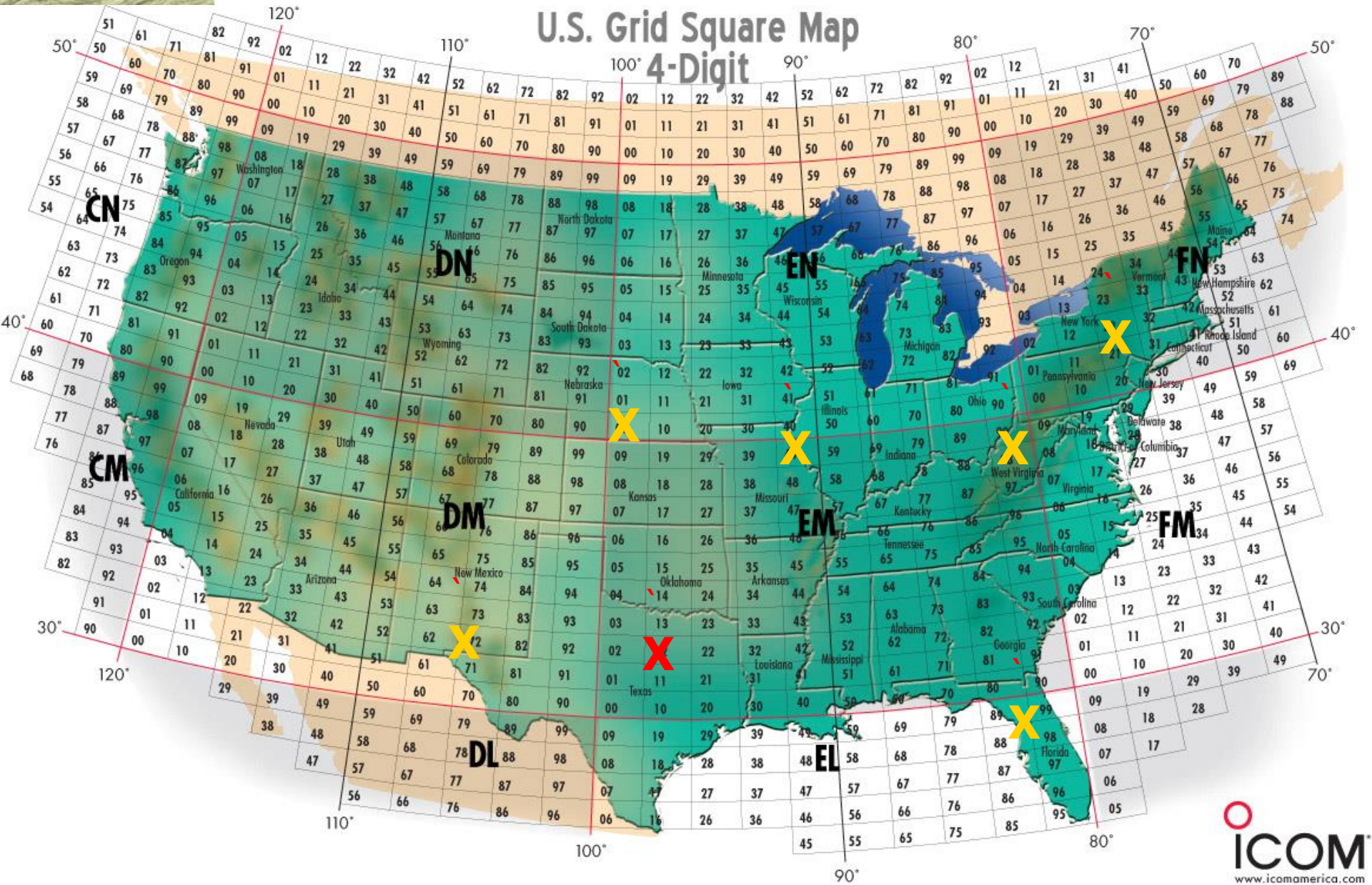
Amateur Radio Satellite Ops.



Amateur Radio Satellite Ops.

- You will hear many different call signs.
- We will try to either call them or respond to their calls to us.
- Example exchange
  - *K2BSA/5 this is WD9EWK*
  - "WD9EWK this is **K2BSA/5 in Echo Mike Twelve**."
  - *K2BSA/5 from WD9EWK in Delta Mike 43 Phoenix*
- You will help us by calling out our call sign and Grid Square
- **K2BSA/5 in Echo Mike 12**

Radio Merit Badge



ICOM
www.icomamerica.com

Radio Merit Badge Requirements

- 9a. *Amateur radio*
  - 1. Tell why the FCC has an amateur radio service. Describe some of the activities that amateur radio operators can do on the air, once they have earned an amateur radio license.
  - 2. Using proper call signs, Q signals, and abbreviations, carry on a 10 minute real or simulated radio contact using voice, Morse Code, or digital mode. (Licensed amateur radio operators may substitute five QSL cards as evidence of contacts with amateur radio operators from at least three different call districts.) Properly log the real or simulated ham radio contact and record the signal report.
  - 3. Explain at least five Q signals or amateur radio terms you hear while listening.
  - 4. Explain some of the differences between the Technician, General, and Extra Class license requirements and privileges. Explain who administers amateur radio exams.
  - 5. Explain how you would make an emergency call on voice or Morse code.
  - 6. Explain the differences between handheld transceivers and home "base" transceivers. Explain the uses of mobile amateur radio transceivers and amateur radio repeaters.

Radio Merit Badge

Lets take a look at our radio for HF communications.

Radio Merit Badge

Lets go work the Birds!!!

AMSAT®

RADIO SCOUTING

Radio Merit Badge

Lunch and other activities,

Lets take a break!!!!

Radio Merit Badge

Welcome back!!!!!

Radio Merit Badge Requirements

- 6. Explain the safety precautions when working with radio gear, including the concept of grounding for DC circuits, power outlets and antenna systems.

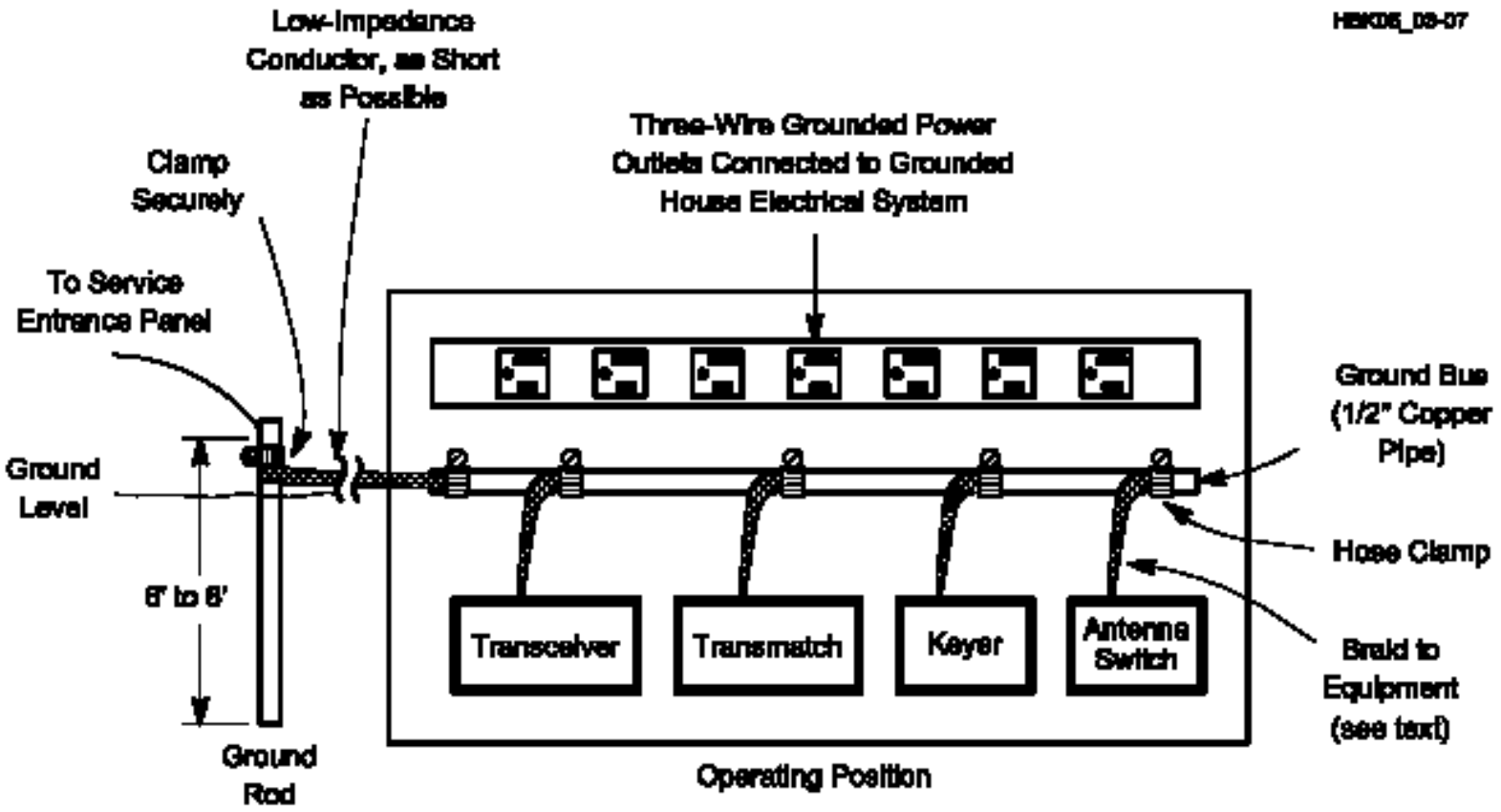
Electrical Safety

- Electronic equipment can run on only a few volts up to several thousand.
- The right amount of current even from a low voltage source passing through the body can kill.
- Proper grounding is key to preventing “floating” voltages between equipment that can cause shocks.
- Grounding can also prevent “RF burns”.

Electrical Safety; Basic rules.

- Never use bare wires or open chassis construction with wires or connections exposed.
- Never work on electrical wiring while the circuit is energized.
- Follow National Electric Code when modifying any electrical circuits. Consult a professional.
- Avoid locating antenna wires where they can come in contact with electrical wires.

Grounding of equipment



RF Safety

- Amateur radio is basically safe in regards to Electromagnetic Radiation exposure. Since transmissions are intermittent, brief exposure to RF fields poses little known hazard.
- The higher the frequency, the more the concern for RF exposure.
- Do avoid placing antennas in areas where the wires can be touched while transmitting.

Radio Merit Badge Requirements

- 8. Find out about three career opportunities in radio. Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.

Related career opportunities

- Electronics design and Engineering
- Radio/TV station maintenance
- Electronic equipment sales/support
- Technical writing
- Videographer
- Radio/Television news
- Telecom system maintenance
- Emergency communications system design and implementation

Related career opportunities

- Education opportunities through;
  - Trade schools like DeVry Institute
  - Community Colleges like Northlake College
  - 4 Year universities like UT and A&M
  - Self study via libraries and Internet
  - On the job experience

Radio Merit Badge Requirements

- 9a. *Amateur radio*
  - 1. Tell why the FCC has an amateur radio service. Describe some of the activities that amateur radio operators can do on the air, once they have earned an amateur radio license.
  - 2. Explain some of the differences between the Technician, General, and Extra Class license requirements and privileges. Explain who administers amateur radio exams.
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Amateur Radio is a Licensed service.

- Amateur Radio is a licensed radio service designed for personal, non-business communication.
- Part 97.3 (4) Amateur service. A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.

Amateur Radio is a Licensed service.

- It is required that a person either possess an FCC issued Amateur license or they work with a licensed **"Control Operator".**
- The FCC currently gives three classes of license, *Technician, General* and *Amateur Extra*.
- License examinations are given by **"Volunteer Examiners"**

What is required to obtain an Amateur Radio license?

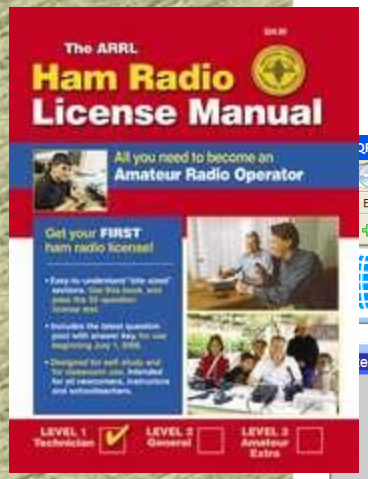
- Age is not a factor.
- Morse code proficiency is no longer required.
- Must pass a multiple choice test administered by an authorized VE team.
- Passing score is 70% of the questions given.
- The entire question pool is available to study and many books and study aids can be found on-line and in print.

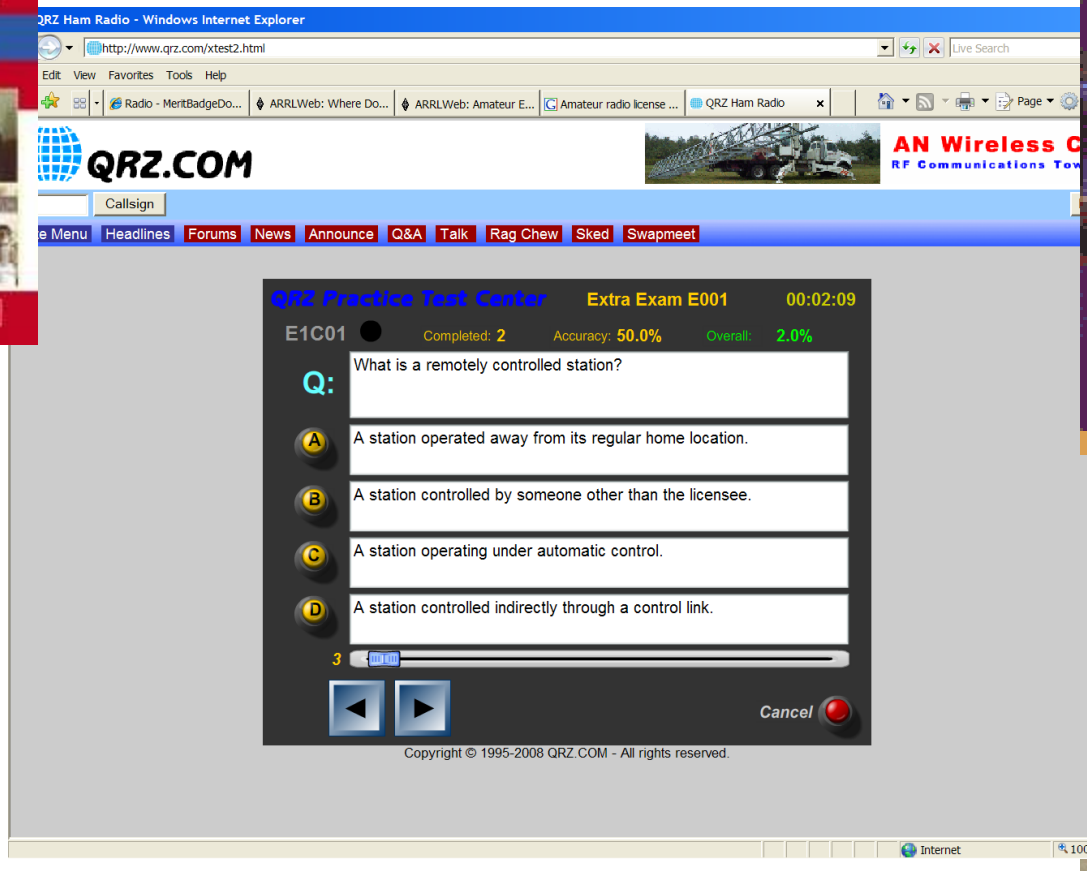
How do I study?

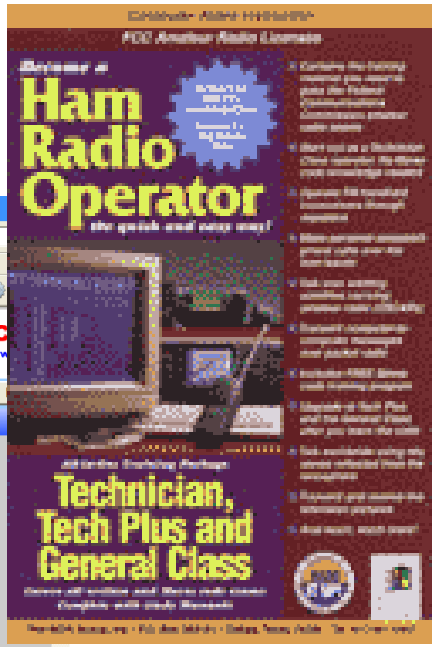
- Options to learn what is needed to pass the exams are many
- Books by ARRL, Gordon West and others.
- Software study aids and practice test engines.
- Online resources like QRZ.com have practice tests and other training resources.
- License classes taught by local amateur radio clubs.

Radio Merit Badge

How do I study?







What is required to obtain an Amateur Radio license?

- **Technician class** license test consists of 35 questions pulled at random from a pool of over 350.
- Covers FCC rules, privileges, operating procedures, basic ohms law electronics theory, propagation and RF safety.
- Privileges are limited on HF bands but unlimited on VHF and above.

http://www.arrl.org/FandES/ead/classes.html

What is required to obtain an Amateur Radio license?

- **General class** license test consists of 35 questions pulled at random from a pool of over 450.
- The written exam covers intermediate regulations, operating practices, and electronics theory, with a focus on HF applications.
- The high-power HF privileges granted to General licensees allow for cross-country and worldwide communication.

http://www.arrl.org/FandES/ead/classes.html

What is required to obtain an Amateur Radio license?

- **Amateur Extra class** license test consists of 50 questions pulled at random from a pool of over 700.
- In addition to some of the more obscure regulations, the test covers specialized operating practices, advanced electronics theory, and radio equipment design.
- Extra Class licensees are authorized to operate on all frequencies allocated to the Amateur Service.

http://www.arrl.org/FandES/ead/classes.html

US Amateur Radio Bands

US AMATEUR POWER LIMITS

At all times, transmitter power should be kept down to that necessary to carry out the desired communications. Power is rated in watts PEP output. Except where noted, the maximum power output is *1500 Watts*.

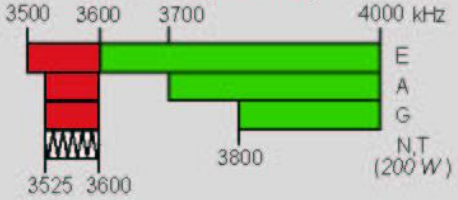
Effective Date
February 23, 2007

Published by:
ARRL The national association for AMATEUR RADIO
www.arrl.org
225 Main Street, Newington, CT USA 06111-1494

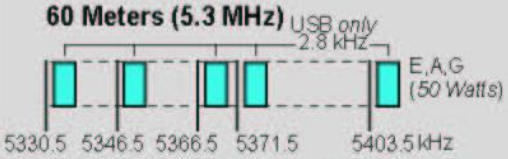
160 Meters (1.8 MHz)

Avoid interference to radiolocation operations from 1900 to 2000 kHz

80 Meters (3.5 MHz)



60 Meters (5.3 MHz)



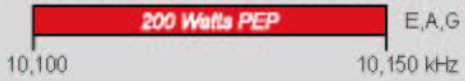
General, Advanced, and Amateur Extra licensees may use the following five channels on a secondary basis with a maximum effective radiated power of 50 W PEP relative to a half wave dipole. Only upper sideband suppressed carrier voice transmissions may be used. The frequencies are 5330.5, 5346.5, 5366.5, 5371.5 and 5403.5 kHz. The occupied bandwidth is limited to 2.8 kHz centered on 5332, 5348, 5368, 5373, and 5405 kHz respectively.

40 Meters (7 MHz)

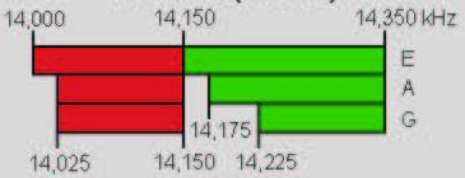
† Phone and image modes are permitted between 7075 and 7100 kHz for FCC licensed stations in ITU Regions 1 and 3 and by FCC licensed stations in ITU Region 2 West of 130 degrees West longitude or South of 20 degrees North latitude. See Sections 97.305(c) and 97.307(f)(11). Novice and Technician licensees outside ITU Region 2 may use CW only between 7025 and 7075 kHz. See Section 97.301(e). These exemptions do not apply to stations in the continental US.

30 Meters (10.1 MHz)

Avoid interference to fixed services outside the US.

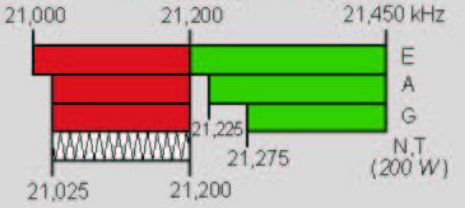


20 Meters (14 MHz)



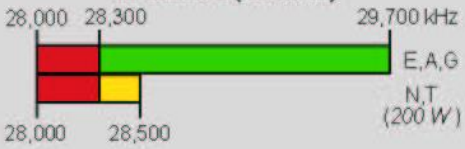
17 Meters (18 MHz)

15 Meters (21 MHz)

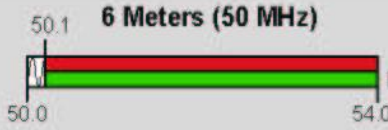


12 Meters (24 MHz)

10 Meters (28 MHz)



6 Meters (50 MHz)



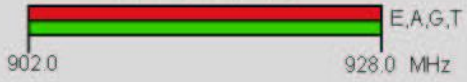
2 Meters (144 MHz)

1.25 Meters (222 MHz)

* Geographical and power restrictions may apply to all bands above 420 MHz. See *The ARRL Operating Manual* for information about your area.

70 cm (420 MHz)*

33 cm (902 MHz)*



23 cm (1240 MHz)*

All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

KEY

Note:
CW operation is permitted throughout all amateur bands except 60 meters.

MCW is authorized above 50.1 MHz, except for 219-220 MHz.

Test transmissions are authorized above 51 MHz, except for 219-220 MHz.

- = RTTY and data
- = phone and image
- = CW *only*
- = SSB phone
- = USB phone *only*
- = Fixed digital message forwarding systems *only*

E = Amateur Extra
A = Advanced
G = General
T = Technician
N = Novice

See *ARRLWeb at www.arrl.org* for more detailed band plans.

ARRL
We're At Your Service

ARRL Headquarters:
860-594-0200 (Fax 860-594-0259)
email: hq@arrl.org

Publication Orders:
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email: orders@arrl.org

Membership/Circulation Desk:
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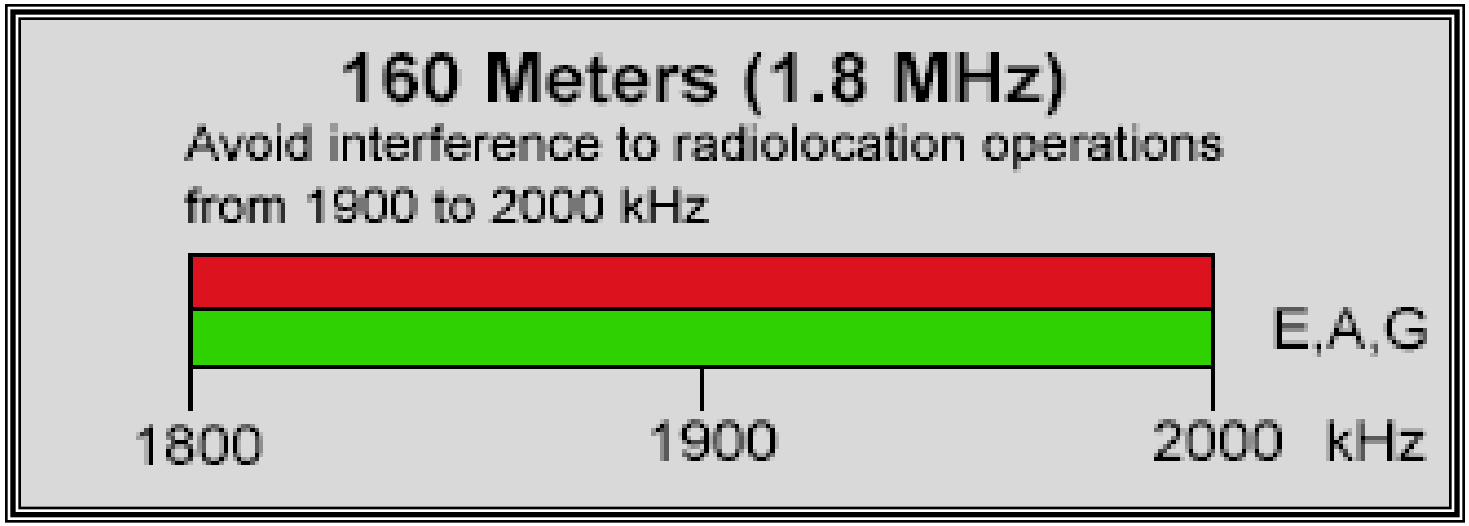
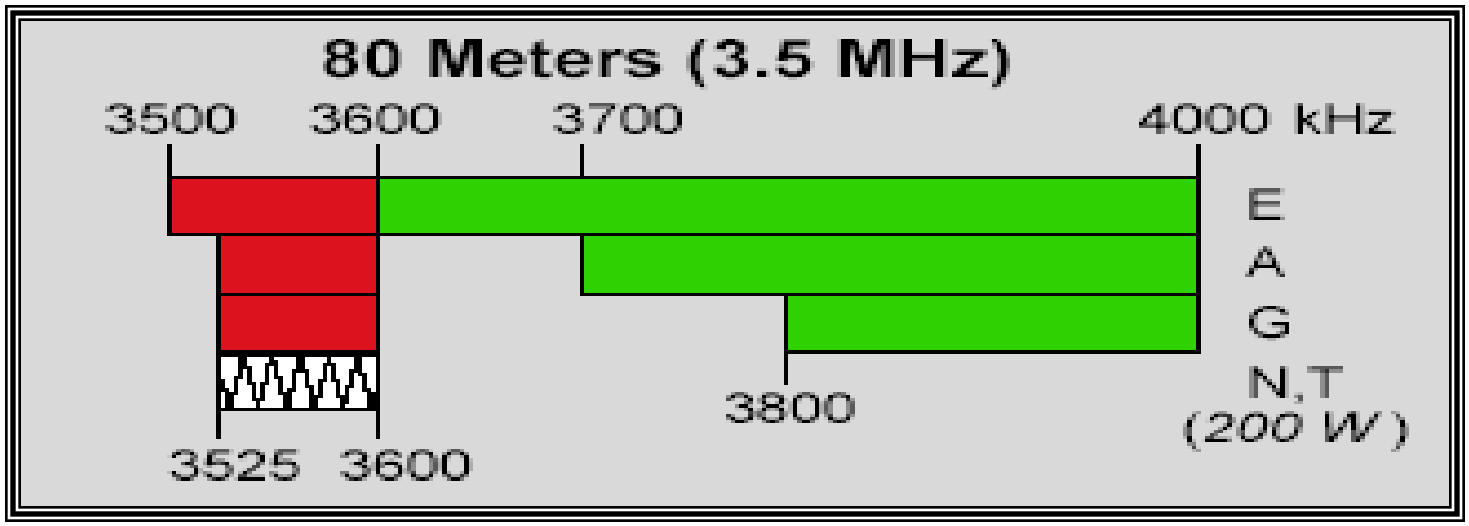
Toll-Free 1-888-277-5289 (860-594-0338)
email: membership@arrl.org

Getting Started in Amateur Radio:
Toll-Free 1-800-326-3942 (860-594-0355)
email: newham@arrl.org

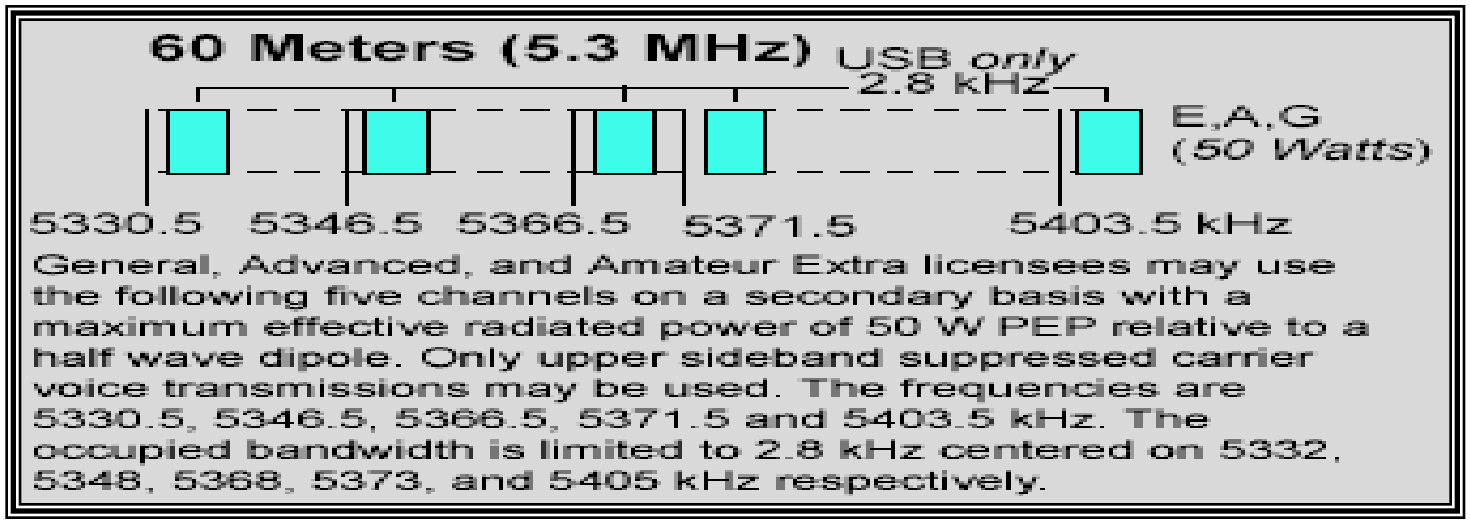
Amateur Bands and Privileges.



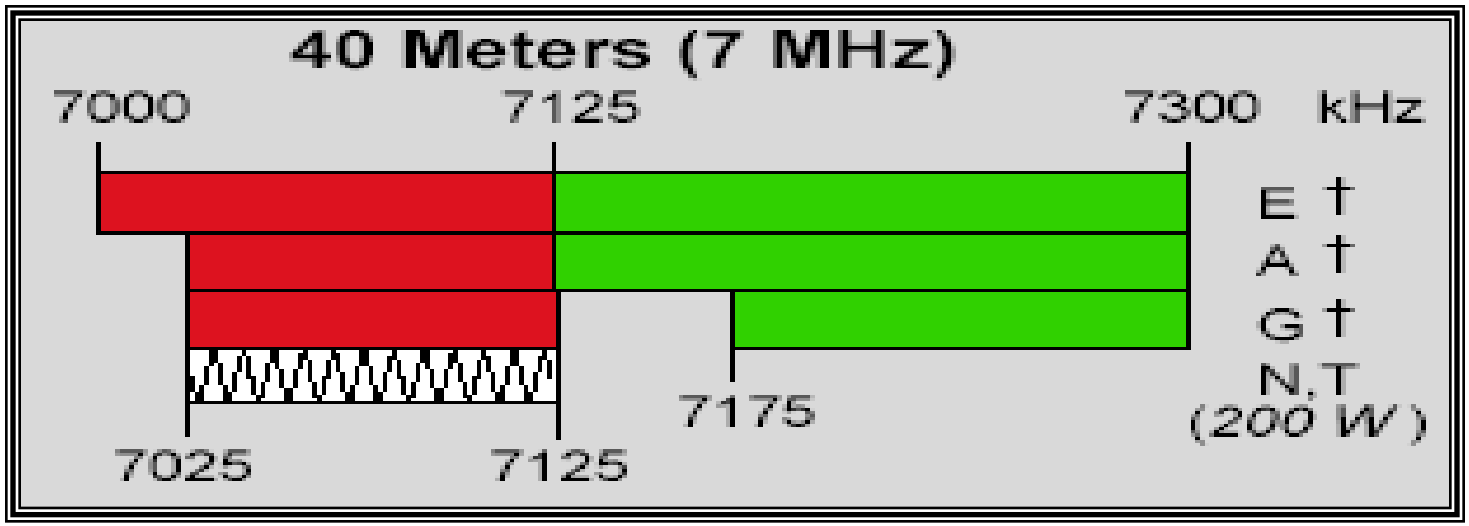
Amateur Bands and Privileges.



Amateur Bands and Privileges.



Amateur Bands and Privileges.



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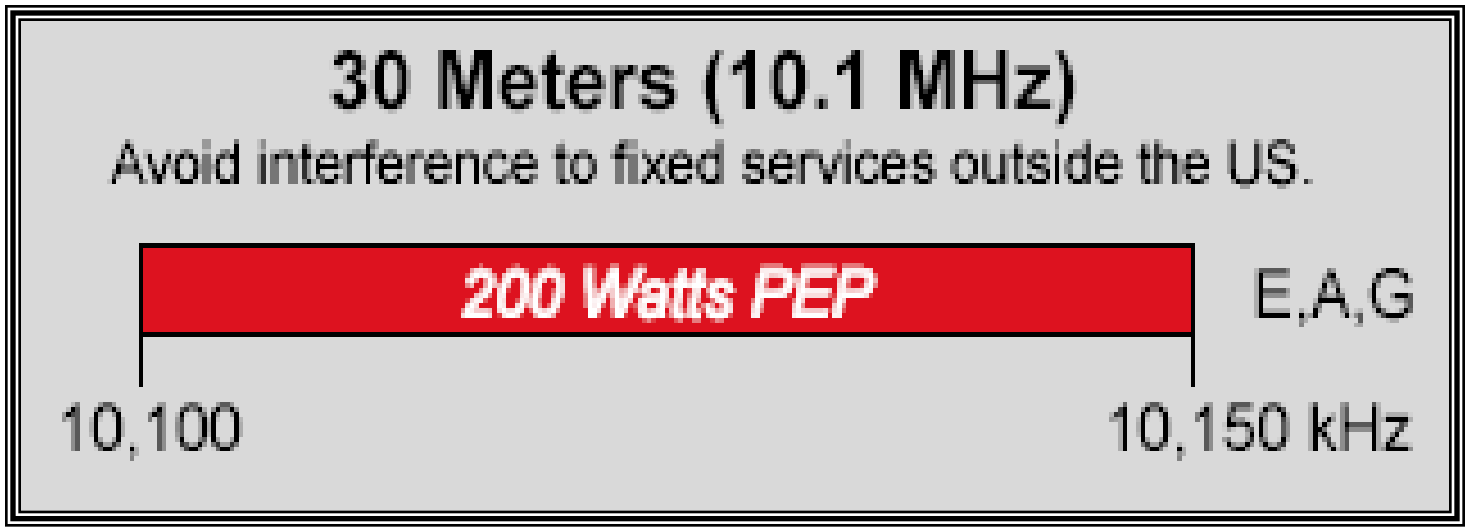

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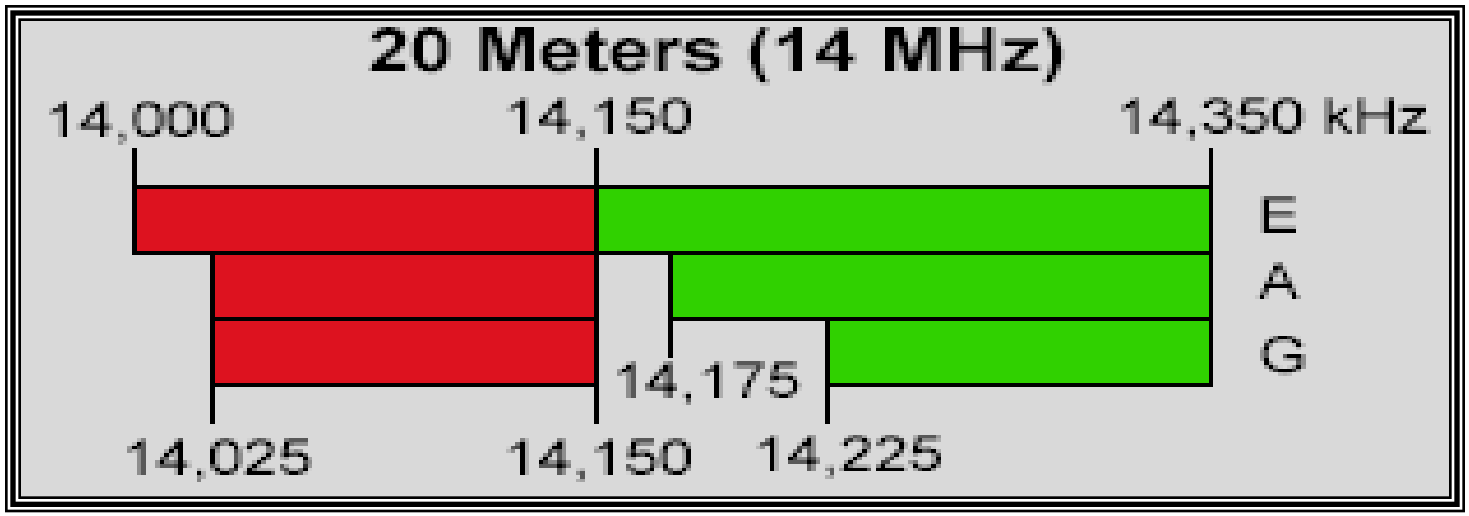

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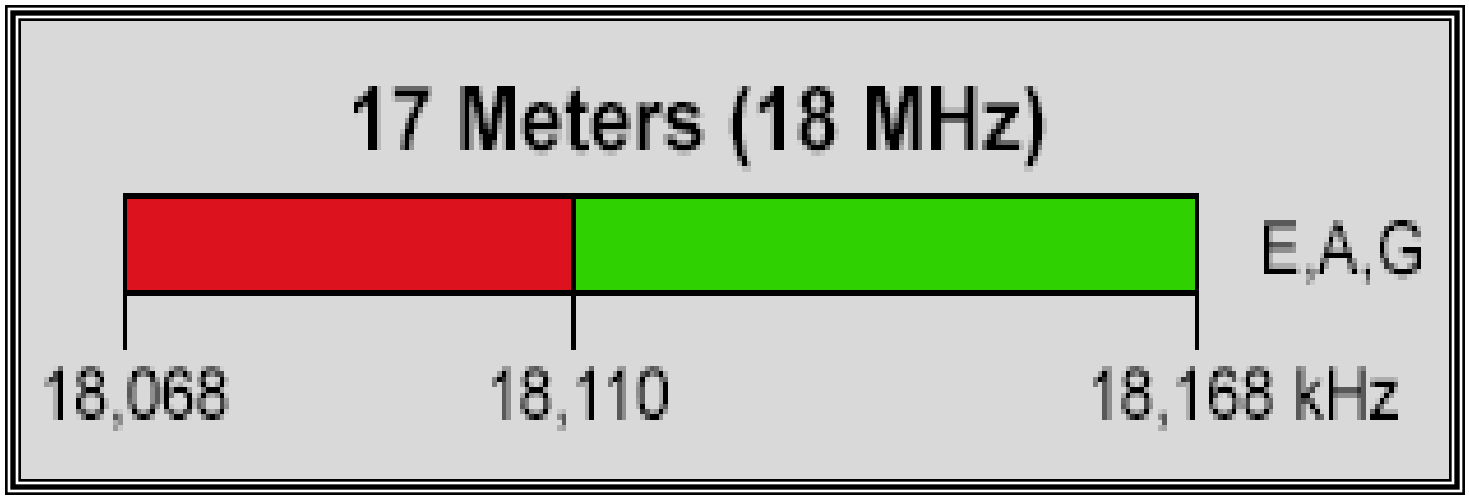

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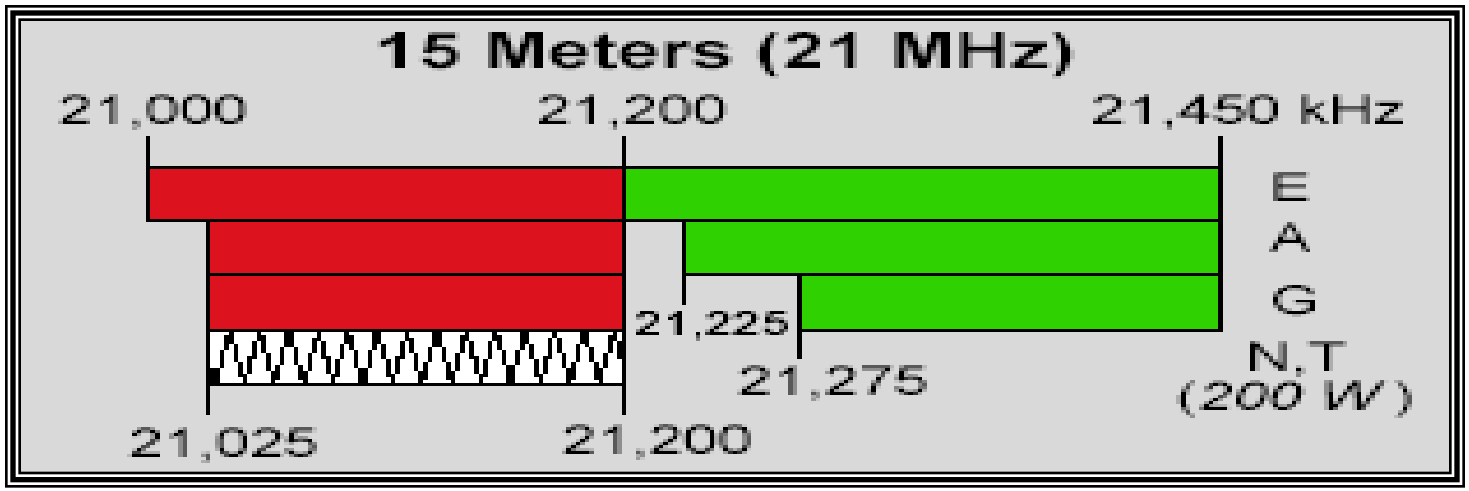

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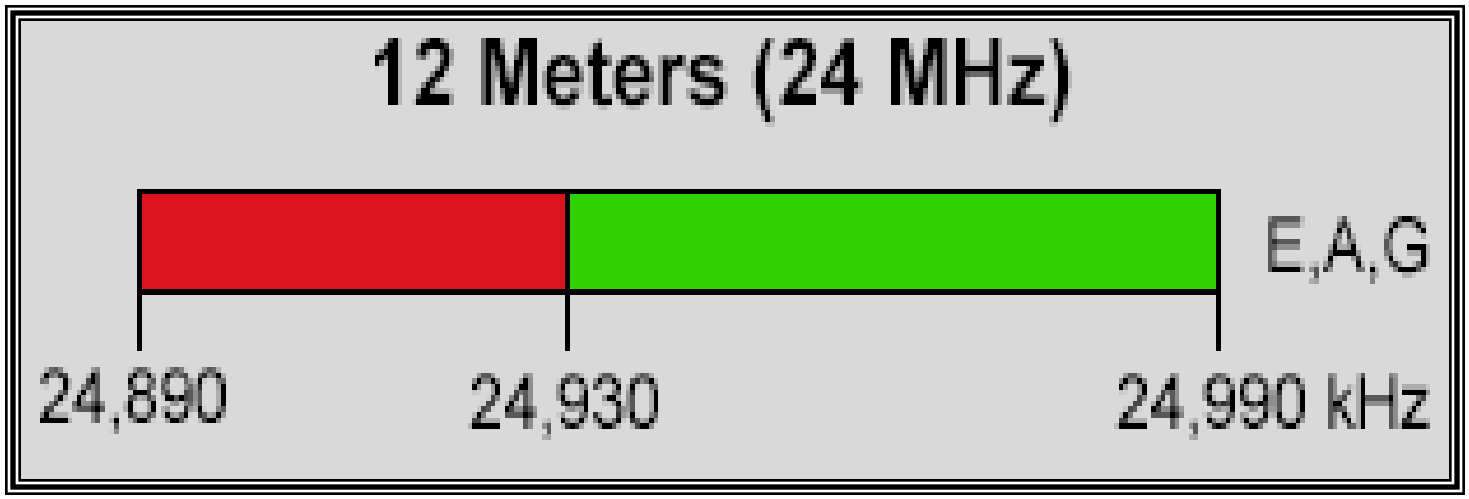

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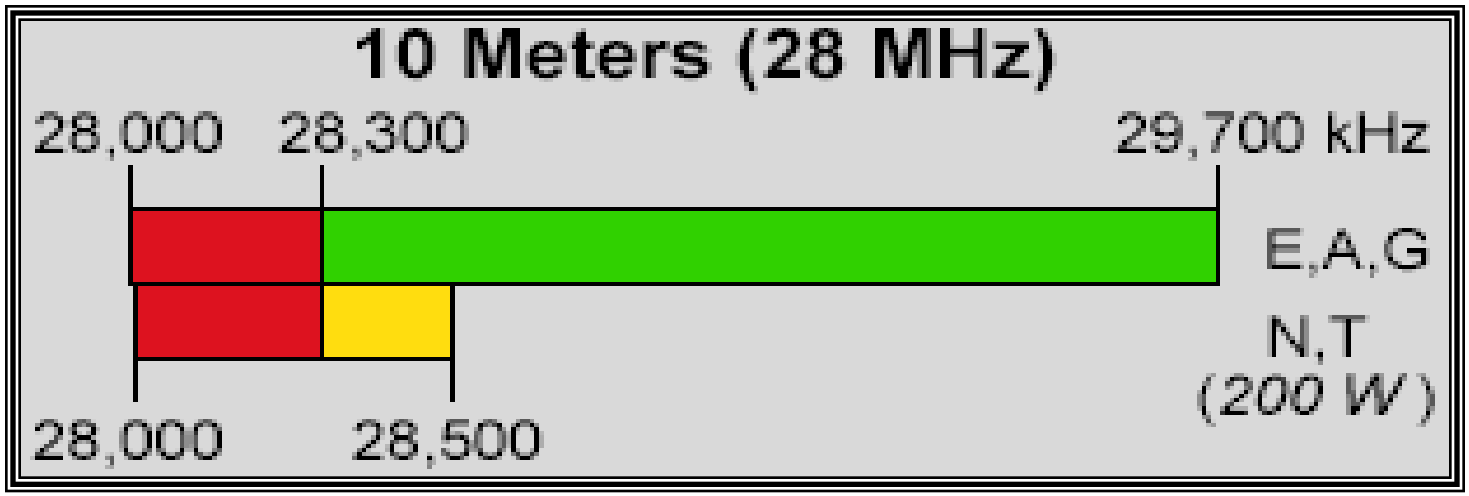
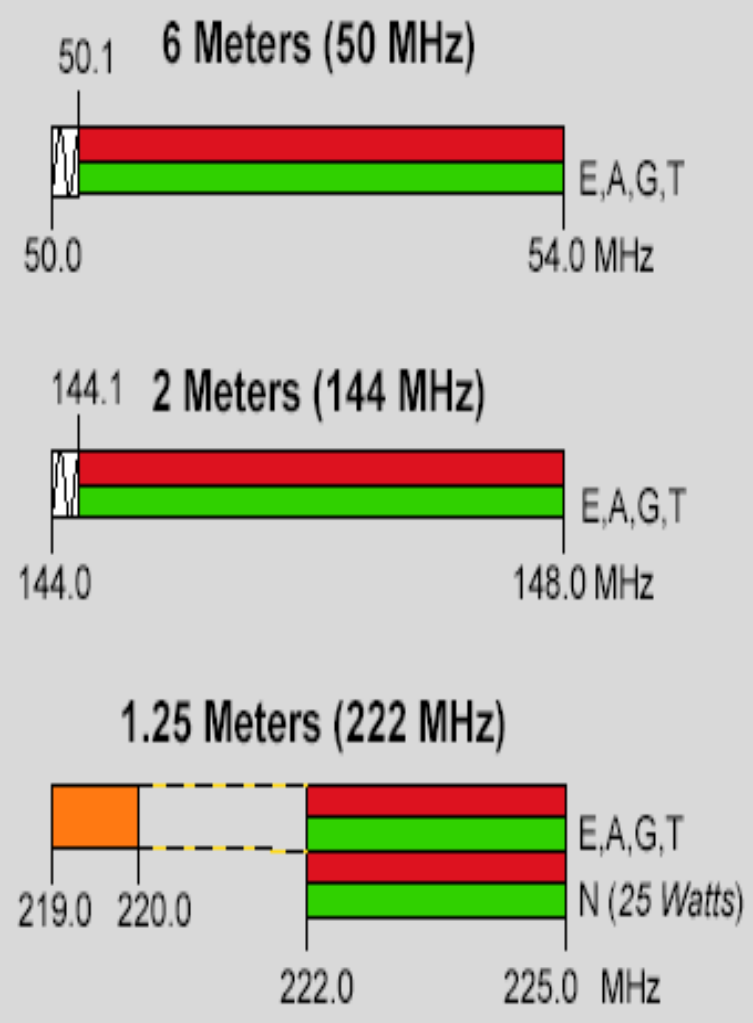
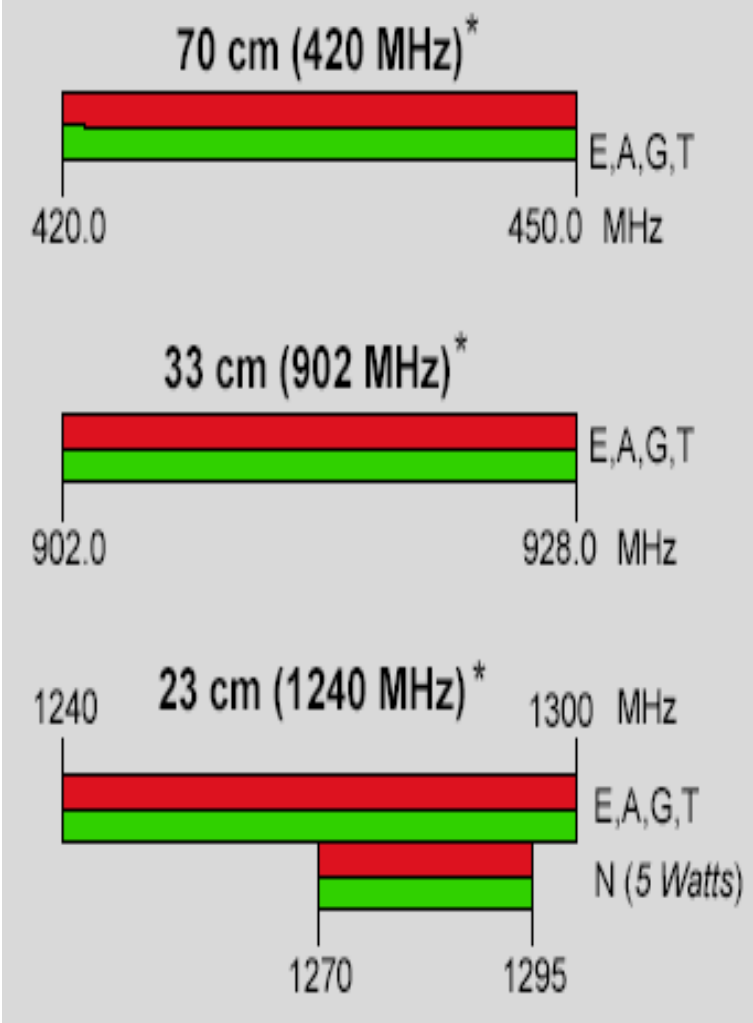


Amateur Bands and Privileges.





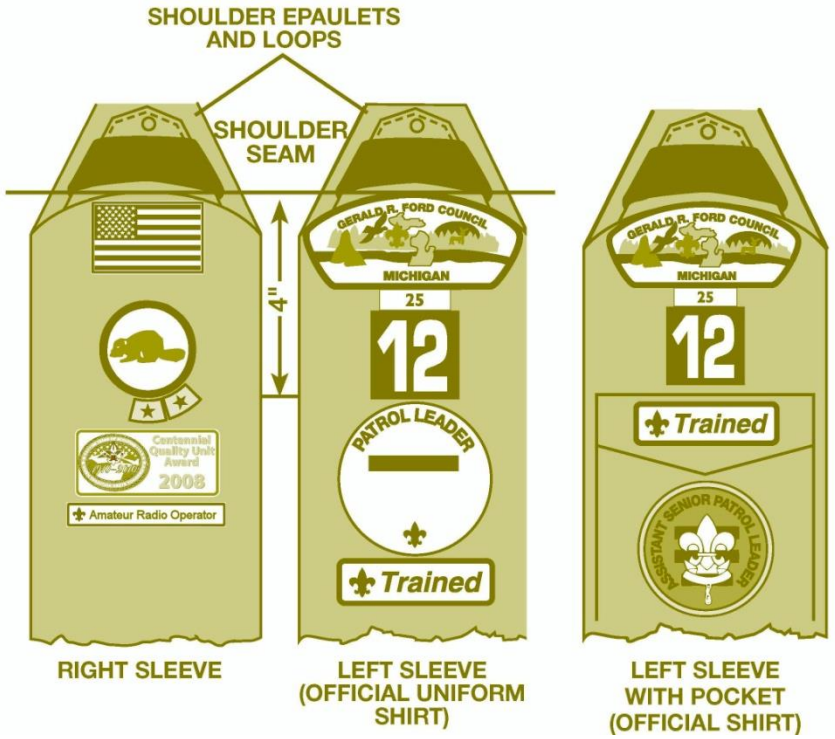
So you get a Ham license, what Can You Do with it?

- Ham radio operators span many age groups and both genders.
- Interests and skills vary widely.
- You can spend tons of money or a very modest sum and still have lots of fun and opportunities to learn and grow.

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

- Scouts and adult leaders with a valid Amateur license can wear the ***Amateur Radio Operator Rating Strip***



Radio Merit Badge

So you get a Ham license, what Can You Do with it?

GOTA
GET ON THE AIR
FIELD DAY

- **Join a local club.**
- Clubs provide many activities and opportunities to grow your skills and meet new people.

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

- Participate in **public service events**.
- Locally, hams lend their communications services to events such as the White Rock Marathon, the Irving 4th of July Parade, Water is Basic 5K walk and the MS 150 bike ride.

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

http://www.southplainscollege.edu/ppress/issue_3_05/spotlight/spotlight_3_05.htm

SKYWARN

EMERGENCY RACES COMMUNICATIONS

- Participate in **emergency preparedness / communications.**
- RACES/ARES events include NWS **SkyWarn** storm spotting and City and county disaster preparedness drills.

AMATEUR RADIO EMERGENCY SERVICE

Irving RACES EOC

Radio Merit Badge

IARC ARRL Field Day 2013

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

- **SkyWarn** is an educational program put on by the National Weather Service.
- **SkyWarn** volunteer storm spotters are the eyes and ears of the NWS in the field
- **Free to the general public** presenting valuable information on severe weather hazards and how to properly report them to the NWS.
- Amateur Radio and the NWS are tightly integrated through SkyWarn.
- Listing of upcoming training events at http://www.weather.gov/fwd/skywarnsch?sptrsch

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

Fig 1.6 — Bill Carter, KG4FXG, helps young Andrea Hartlage, KG4IUM, work her way through her first CW contact.

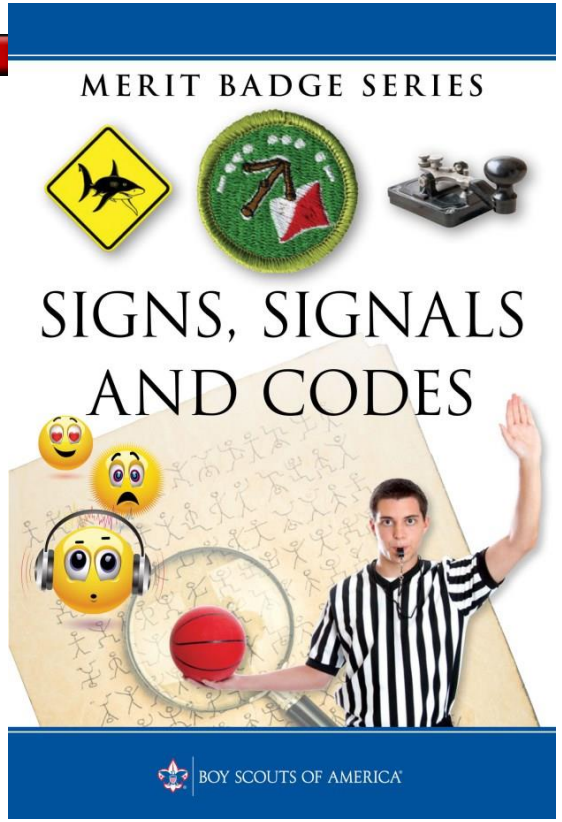
- Learn **Morse Code**!
- Code proficiency may no longer be required for a license, but many times CW is the only mode that will get through.

ARRL Amateur Radio Handbook, ©2005

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

- Study Morse Code as a part of this Merit badge and earn an Interpreter strip in the process.



Radio Merit Badge

So you get a Ham license, what Can You Do with it?

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

- **Contesting.**
- Almost every weekend there is some sort of regional, national or world wide contest activity
- Sharpen operating skills and feel the adrenalin rush.

CQ

160 Meter Contest

WPX Phone Contest

CQ DX Contest

TEN - TEN INTERNATIONAL NET

10-10 10 Meter contest

ARRL The national association for AMATEUR RADIO

VHF QSO Party

10 GHz and Up

Filed Day

ARRL DX contest

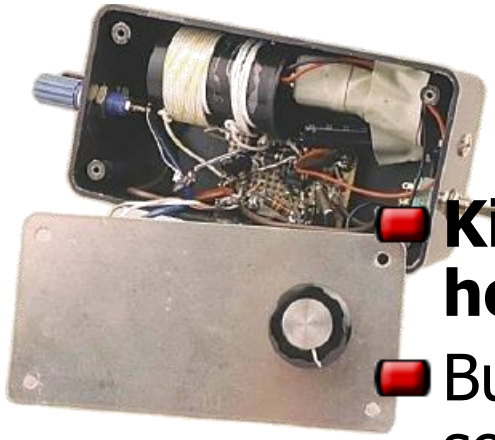
AMATEUR RADIO CLUB 1961 QRP ARCI K6JSS INTERNATIONAL

QRP ARCI Contest

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

http://www.fix.net/~jparker/wilderness/sst.htm



- **Kit building and homebrewing.**
- Build radio gear from someone else's design or design your own from scratch.
- Grow understanding of electronic principles and feel the accomplishment of putting your own creation on the air..

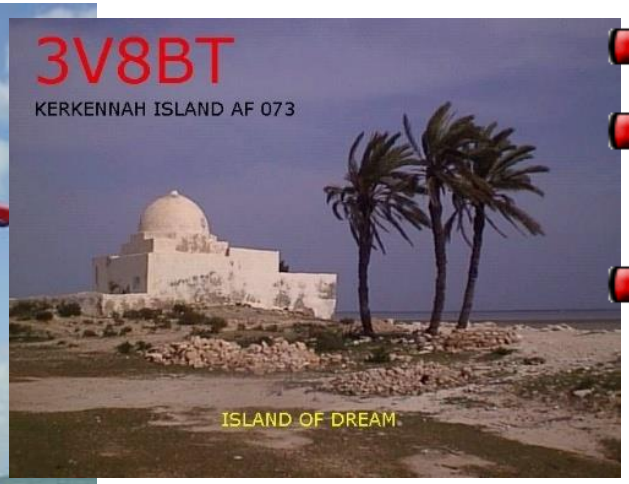
Vectronics 80M QRP transceiver kit $59

http://www.vectronics.com/products.php?prodid=VEC-1380K

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

BS7H Scarborough Reef, Indian Ocean, 2007



- **DX**
- Make contacts with hams all over the world.
- Earn recognition for your efforts, DXCC and Honor roll.
- Learn about different ionospheric and atmospheric propagation modes.
- Satisfaction of "Breaking the pile-UP

4O3T Montenegro, 2006

http://www.yu6scg.cg.yu/international-dx-festival-montenegro-2006

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

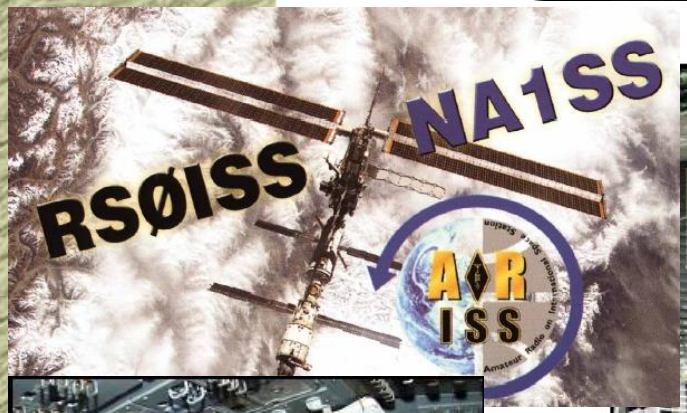


Fig 1.14 — Astronaut Susan Helms, KC7NHZ, made several dozen Field Day contacts operating from the ISS as NA1SS. *(NASA Photo)*

Fig 1.13 — Most communication with unmanned satellites uses VHF, UHF or microwave frequencies, and many hams build their own antennas for this pursuit.

- **Satellite / ISS communications**
- Since the ’60s Amateurs have financed the launch of numerous satellites designed for ham communications.
- Learn antenna design, orbital mechanics and operating skills while talking around the world.

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

- **Satellite / ISS communications**
- Since the ’60s Amateurs have financed the launch of numerous satellites designed for ham communications.
- Learn antenna design, orbital mechanics and operating skills while talking around the world.

Radio Merit Badge

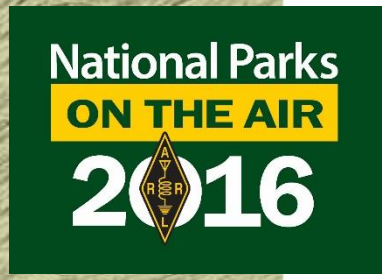
So you get a Ham license, what Can You Do with it?

www.mtechnologies.com/pubs/qrp.htm

- **QRP – Low power operation**
- Work the world on milliwatts.
- Build your own gear or buy commercial radios.
- Take HF radio on a camping or hiking adventure.

Radio Merit Badge

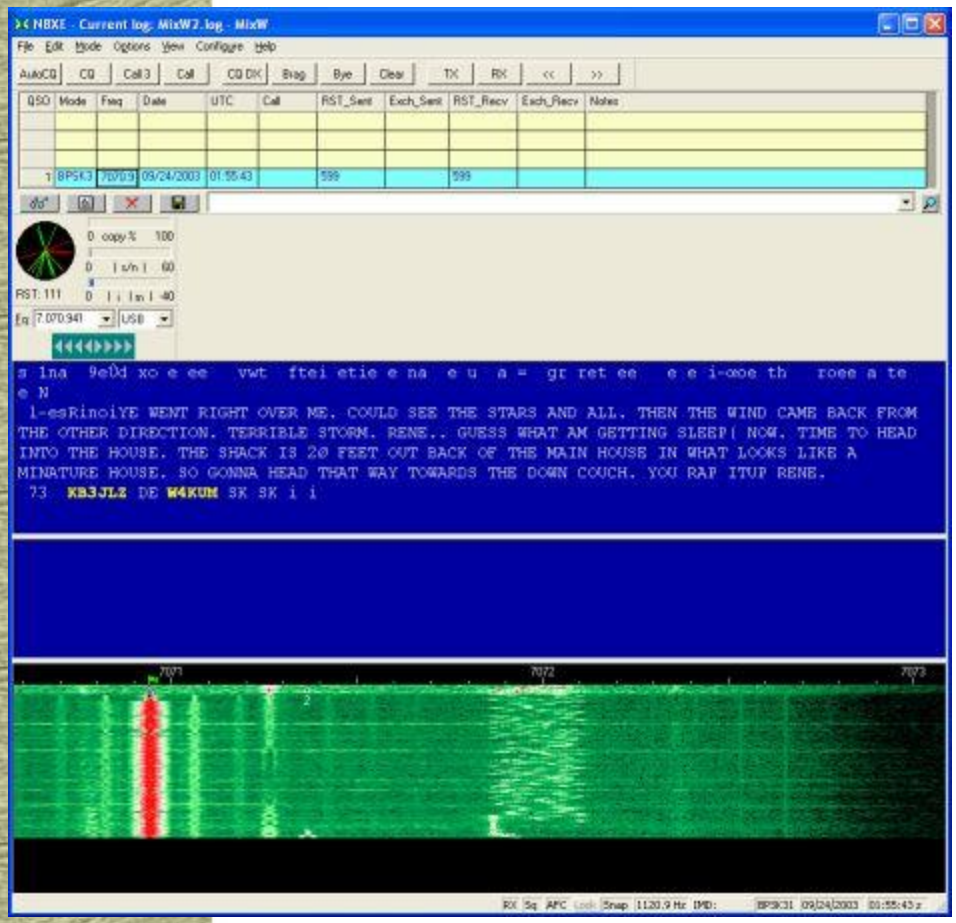
So you get a Ham license, what Can You Do with it?



- **SOTA – Summits on the Air**
- **IOTA –Islands on the Air**
- **NPOTA – National Parks on the Air**
- All these are great ways to get out and operate from unique places.

Radio Merit Badge

So you get a Ham license, what Can You Do with it?



- **Digital modes.**
- HF modes like PSK31 and MFSK16 play from a computer soundcard.
- VHF/UHF digital modes like D-STAR bring digital voice, data and image to mobile communications

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

THE AMERICAN RADIO RELAY LEAGUE

RADIOGRAM

VIA AMATEUR RADIO

NUMBER	PRECEDENCE	HX	STATION OF ORIGIN	CHECK	PLACE OF ORIGIN	TIME FILED	DATE
1	EMERGENCY		NC4EO	19	RALEIGH, NC	1400E	AUG. 14

TO GOVERNOR MICHAEL EASLEY
GOVERNOR'S OFFICE BUILDING
500 BLOUNT ST.
RALEIGH, NC 27601

TELEPHONE NUMBER 919 555 1212

THIS RADIO MESSAGE WAS RECEIVED AT
AMATEUR STATION _____ PHONE _____
NAME _____
STREET ADDRESS _____
CITY, STATE, ZIP _____

ALL	WATER	SUPPLIES	ARE	CONTAMINATED
X	NEED	TO	USE	ONLY
BOTTLED	WATER	UNTIL	FURTHER	NOTICE
X	CALL	FOR	CLARIFICATION	

SIGNATURE JOHN SMITH NC EMERGENCY MANAGEMENT DIRECTOR 919 999 9999

REC'D FROM	DATE	TIME	SENT TO	DATE	TIME
K4RLC	8/14	1422	KG4HDT	8/14	1510

THIS MESSAGE WAS HANDLED FREE OF CHARGE BY A LICENSED AMATEUR RADIO OPERATOR, WHOSE ADDRESS IS SHOWN IN THE BOX AT RIGHT ABOVE. AS SUCH MESSAGES ARE HANDLED SOLELY FOR THE PLEASURE OF OPERATING, NO COMPENSATION CAN BE ACCEPTED BY A "HAM" OPERATOR. A RETURN MESSAGE MAY BE FILED WITH THE "HAM" DELIVERING THIS MESSAGE TO YOU. FURTHER INFORMATION ON AMATEUR RADIO MAY BE OBTAINED FROM ARRL HEADQUARTERS, 225 MAIN STREET, NEWINGTON, CT 06111

THE AMERICAN RADIO RELAY LEAGUE, INC. IS THE NATIONAL MEMBERSHIP SOCIETY OF LICENSED RADIO AMATEURS AND THE PUBLISHER OF *QST* MAGAZINE. ONE OF ITS FUNCTIONS IS PROMOTION OF PUBLIC SERVICE COMMUNICATION AMONG AMATEUR OPERATORS. TO THAT END, THE LEAGUE HAS ORGANIZED THE NATIONAL TRAFFIC SYSTEM FOR DAILY NATIONWIDE MESSAGE HANDLING.

PRINTED IN USA

- **Traffic Handling**
- Relay messages for third parties via radio.
- May seem antiquated with Internet and Cell Phones, but what if those technologies break during a disaster.

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

- **Vintage Radio Restoration**
- Pick up old radio gear for next to nothing and return it to operating shape.

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

- **Radio Direction Finding (Fox Hunting)**
- Be the first to find the hidden transmitter, nasty power line noise or that stuck microphone.

Radio Merit Badge

Jamboree on the Air

Jamboree on the Air

- World Scouting event.
- Scouts from all over the world connecting with Scouts via Amateur Radio.
- October 18th, 19th and 20th, 2019.
- Many locations in US will have JOTA activities.
- **There should be a number of JOTA events in various places in the Metro.**
- You are having fun today, spread the ***JOTA*** word.

Radio Merit Badge Requirements

- 9a. *Amateur radio*
  - 1. Tell why the FCC has an amateur radio service. Describe some of the activities that amateur radio operators can do on the air, once they have earned an amateur radio license.
  - 2. Using proper call signs, Q signals, and abbreviations, carry on a 10 minute real or simulated radio contact using voice, Morse Code, or digital mode. (Licensed amateur radio operators may substitute five QSL cards as evidence of contacts with amateur radio operators from at least three different call districts.) Properly log the real or simulated ham radio contact and record the signal report.
  - 3. Explain at least five Q signals or amateur radio terms you hear while listening.
  - 4. Explain some of the differences between the Technician, General, and Extra Class license requirements and privileges. Explain who administers amateur radio exams.
  - 5. Explain how you would make an emergency call on voice or Morse code.
  - 6. Explain the differences between handheld transceivers and home "base" transceivers. Explain the uses of mobile amateur radio transceivers and amateur radio repeaters.

Types of Amateur Radio Gear

- There are three basic types of radio gear.
  - Base station
  - Mobile station
  - Portable station
- The shrinking size of modern electronics devices has blurred the lines.

Types of Amateur Radio Gear

- Base Station equipment is considered to be permanently installed.
- Known by amateurs as “The Ham Shack”, permanent place where operations come from.
- Antenna structures vary but are for the most part permanently installed.

Types of Amateur Radio Gear

- Several examples of permanent Ham installations.

www.ky1v.com/shack.htm

Yaesu
FT 101

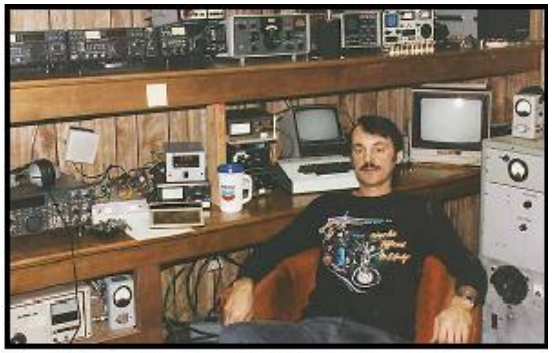


Fig 19.8—Richard, WB5DGR, uses a homebrew 1.5-kW amplifier to seek EME contacts from this nicely laid out station

ARRL Amateur Radio Handbook, ©2005

Yaesu
FT9000

Types of Amateur Radio Gear

- Mobile radios can be either HF or VHF/UHF varieties.
- Should be able to operate off the 12V power source provided by most vehicles.
- Antennas are mounted to the vehicle and in most cases, use the vehicle body as a “Ground Plane”.

Types of Amateur Radio Gear

- Several examples of mobile Ham installations.

Yaesu FT 8900R

www.eham.net/articles/17265

hampgh.com/shacks.aspx

Types of Amateur Radio Gear

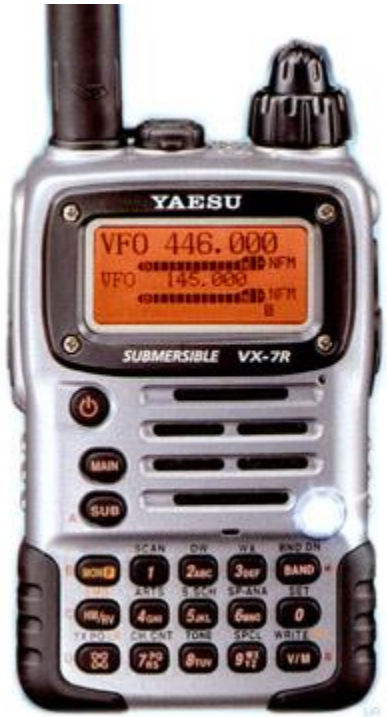
- Portable gear is not installed in any permanent way so it can be moved quickly and easily.
- Used for hiking, camping, or emergency communications.
- Antenna systems also need to be easily transportable.

Types of Amateur Radio Gear

- Some examples of portable Ham gear.

Yaesu FT
FT 817

www.k8zt.com/qq.html



Yaesu FT
VX-7R

www.hamradiofun.com/yo-yo-vee.htm

The "REPEATER"

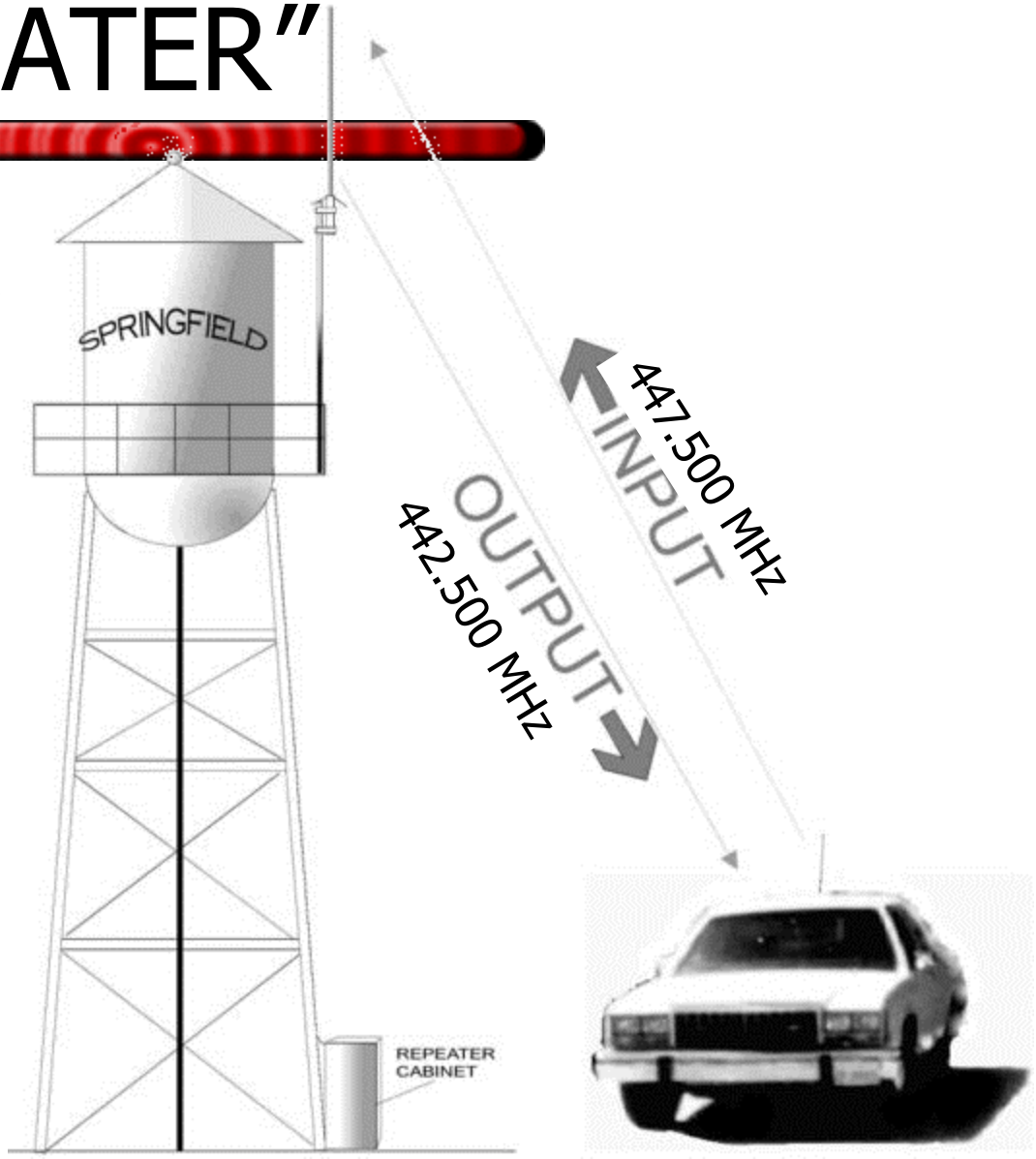
- VHF and UHF mobile and portable operators usually have low to the ground antennas.
- Since these radio frequencies travel mainly by line of sight, communication across a wide local area would be very limited.
- Amateur are allowed by the FCC to operate **Repeaters.**

The "REPEATER"

- A **Repeater** is a special ***Transmitter/Receiver*** pair.
- Repeaters are usually located on tall towers, buildings or on the tops of hills.
- They receive a transmission on one frequency and retransmit that signal simultaneously on another. They ***REPEAT*** what they hear.
- An example: Irving Amateur Radio Club 2 Meter repeater transmits on 146.72 MHz but receives on 146.12.

The "REPEATER"

- This example of a amateur UHF repeater shows how the mobile stations transmit frequency is relayed out on a different frequency.
- **OFFSET** is the term that defines the difference between the input and output frequencies. It can be either + or -.
- This offset keeps the two from interfering with each other.



SIMPLEX vs. DUPLEX

- If VHF/UHF stations are close enough to hear themselves easily line of sight, then talk ***SIMPLEX***.
- Both parties talk and listen on the same frequency. No other radio goes between the two parties.
- If reception is impaired or un-readable by distance or terrain, then **repeaters** should be used.

SIMPLEX vs. DUPLEX

- Repeater usage is considered **HALF (Semi) DUPLEX** because you can only listen to the output of the repeater when you are not transmitting.
- *The Repeater is always doing both.*
- **FULL DUPLEX** is when you can talk and listen at the same time.
- A telephone is a FULL DUPLEX device but so can be a **CROSSBAND REPEATER**.

Radio Merit Badge Requirements

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  - 6. Explain the differences between handheld transceivers and home "base" transceivers. Explain the uses of mobile amateur radio transceivers and amateur radio repeaters.

Emergency communication and the radio amateur

- Part 97.403 of the FCC rules states…
- *No provision of these rules prevents the use by an amateur station of any means of radiocommunication at its disposal to provide essential communication needs in connection with the immediate safety of human life and immediate protection of property when normal communication systems are not available.*

Emergency communication and the radio amateur

- The rules thus state that an Amateur Radio Operator may use any means and may attempt to contact users of other licensed services in the event of an actual emergency that threatens life or property.
- **Just make sure it is truly an emergency. Stiff fines may result from false reporting.**

Emergency communication and the radio amateur

- Part 97.401 of the FCC rules states…
- *(a) When normal communication systems are overloaded, damaged or disrupted because a disaster has occurred, or is likely to occur, in an area where the amateur service is regulated by the FCC, an amateur station may make transmissions necessary to meet essential communication needs and facilitate relief actions.*
- This is a good definition of **Emergency communications.**

Emergency communication and the radio amateur

- Part 97.405 of the FCC rules states…
- *(a) No provision of these rules prevents the use by an amateur station in distress of any means at its disposal to attract attention, make known its condition and location, and obtain assistance.*
- *(b) No provision of these rules prevents the use by a station, in the exceptional circumstances described in paragraph (a), of any means of radiocommunications at its disposal to assist a station in distress.*

Emergency communication and the radio amateur

- You are allowed to use any means to attract attention to your distress
- Accepted procedures are;
  - *On voice modes, use **MAYDAY** followed by your call and wait for a response.*
  - *On CW, use **SOS** followed by your call and wait for a response.*
  - *If barging into an ongoing QSO, use **BREAK BREAK** and wait for response.*

Emergency communication and the radio amateur

- Be prepared to give the following information.
  - The location of the distress, address etc.
  - The nature of the distress.
  - Type of assistance required, medical evacuation, food, clothing etc.
  - Any other information to help locate the emergency area.

Emergency communication and the radio amateur

- In the wake of a major national emergency, the FCC may change it's rules to make a **Temporary State of Communications Emergency.**
- The FCC may restrict communications on certain frequencies to only those needed to facilitate the emergency communications.

Radio Merit Badge Requirements

- **9D. *Amateur radio Direction Finding.***
- (1) Describe amateur radio direction finding and explain why direction finding is important as both an activity and in competition.
- (2) Describe what frequencies and equipment are used for ARDF or fox hunting.
- (3) Build a simple directional antenna for either of the two frequencies used in ARDF.
- (4) Participate in a simple fox hunt using your antenna along with a provided receiver.
- (5) Using your receiver, show on a map how you located the "fox."

Radio Merit Badge

So you get a Ham license, what Can You Do with it?

- **Radio Direction Finding (Fox Hunting)**
- Be the first to find the hidden transmitter, nasty power line noise or that stuck microphone.

Amateur Radio Direction Finding

- Can be a very challenging addition to orienteering for Geoching activities.
- Can be run as a competition either on foot or in vehicles.
- Skills in ARDF can help in search and rescue situations.
- Can be used to track down harmful interference or malicious jamming.

Amateur Radio Direction Finding

- Chris Shanahan, KE5KPC will give you an overview of how radio direction finding works and you will have a chance to hunt down a “Fox”.

Radio Merit Badge

You now have the basics.

Now get the license, get on the air and have some fun.

Thanks for participating,

Tom Schuessler, N5HYP

RADIO SCOUTING

Radio Merit Badge

Lets get on the air & make some contacts!!!