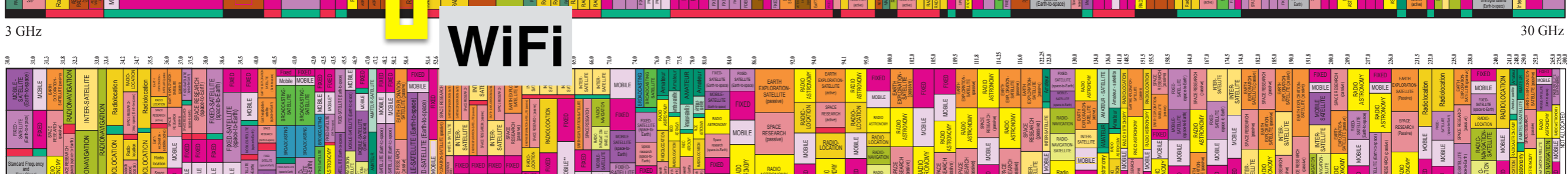
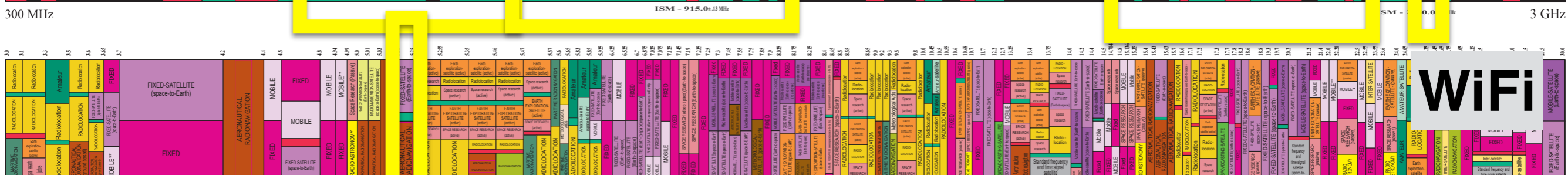
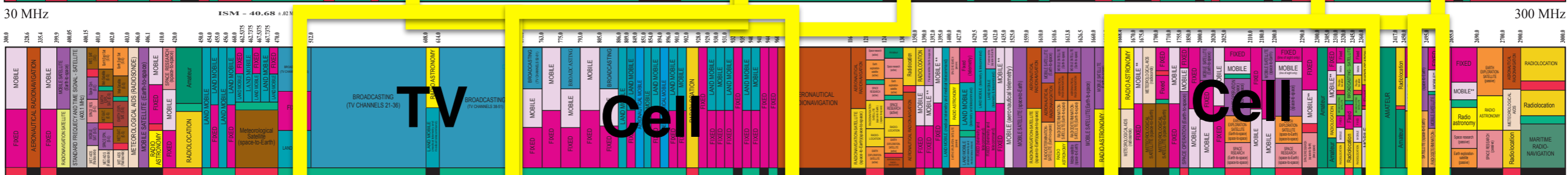
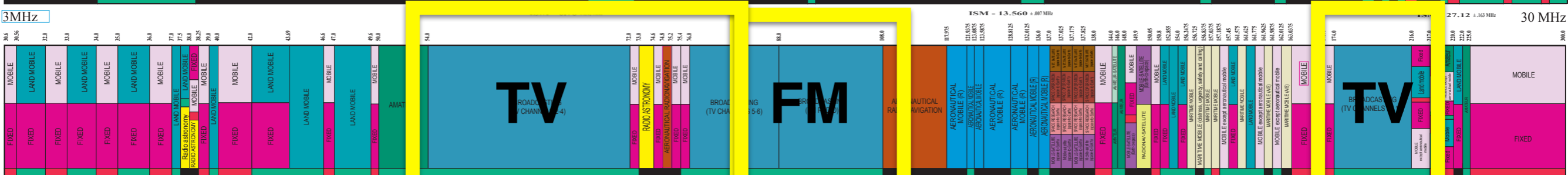
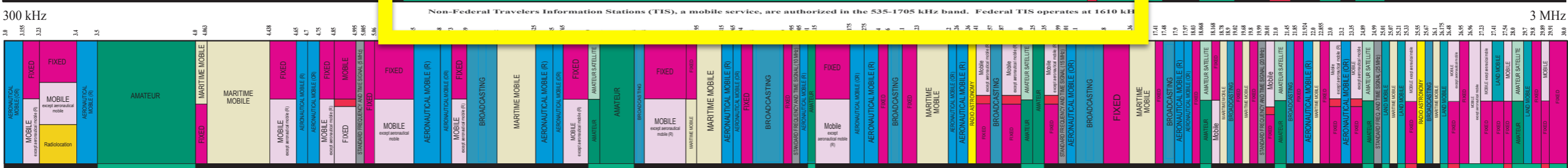
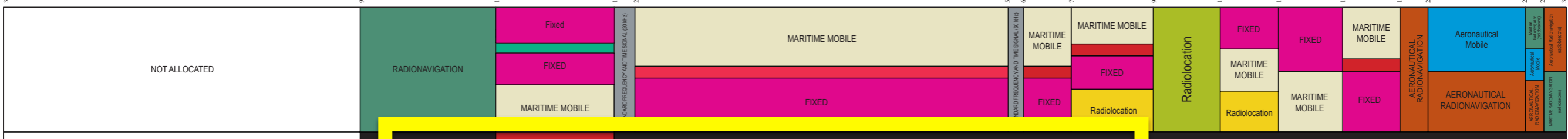


# Amateur Radio License

*FM Handheld Radios, Simplex, and  
Repeaters*

# Today's Topics

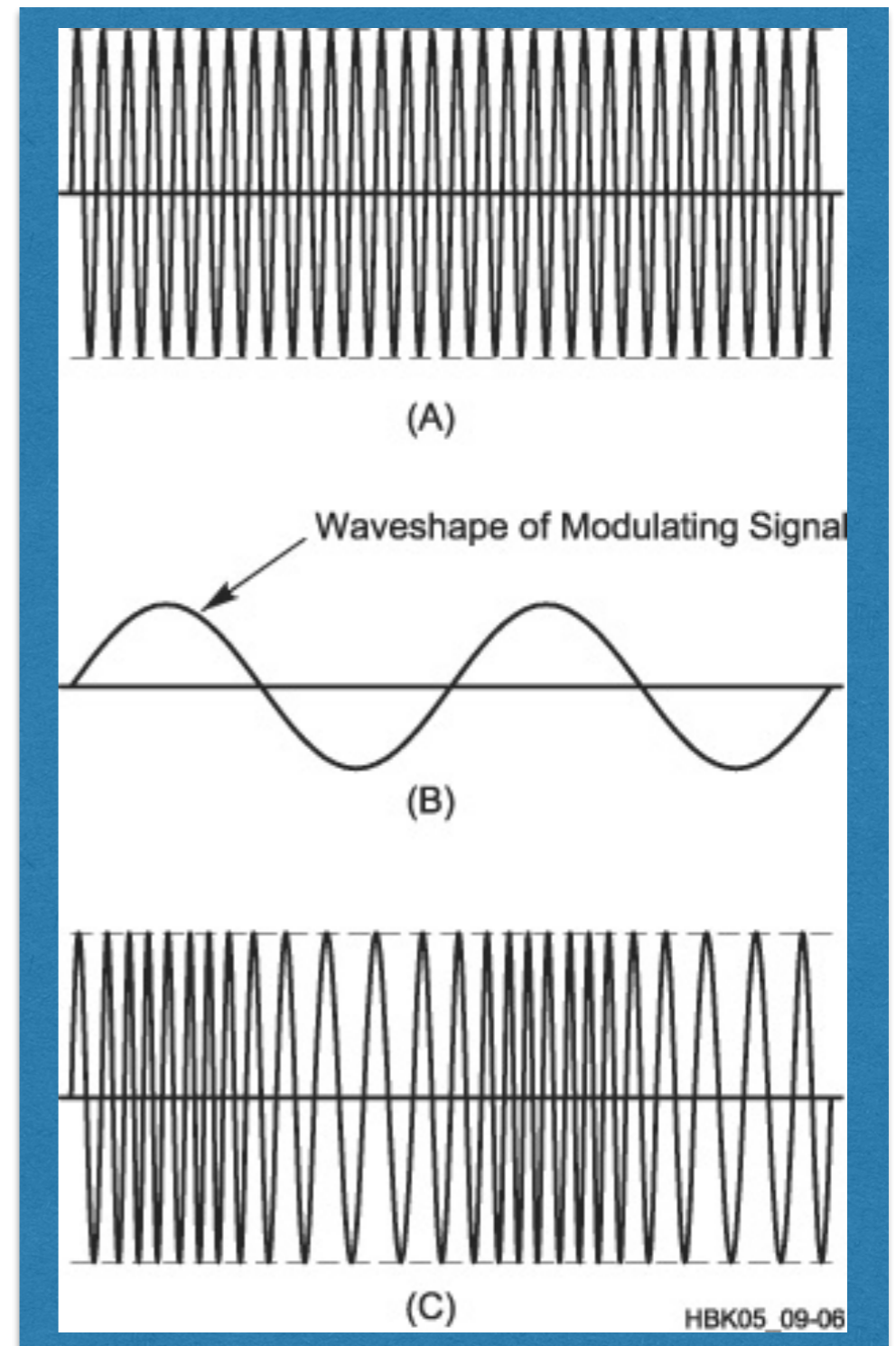
- FM, Frequencies
- FM Radios
- VHF/UHF Propagation
- Simplex
- Repeaters





# Frequency Modulation

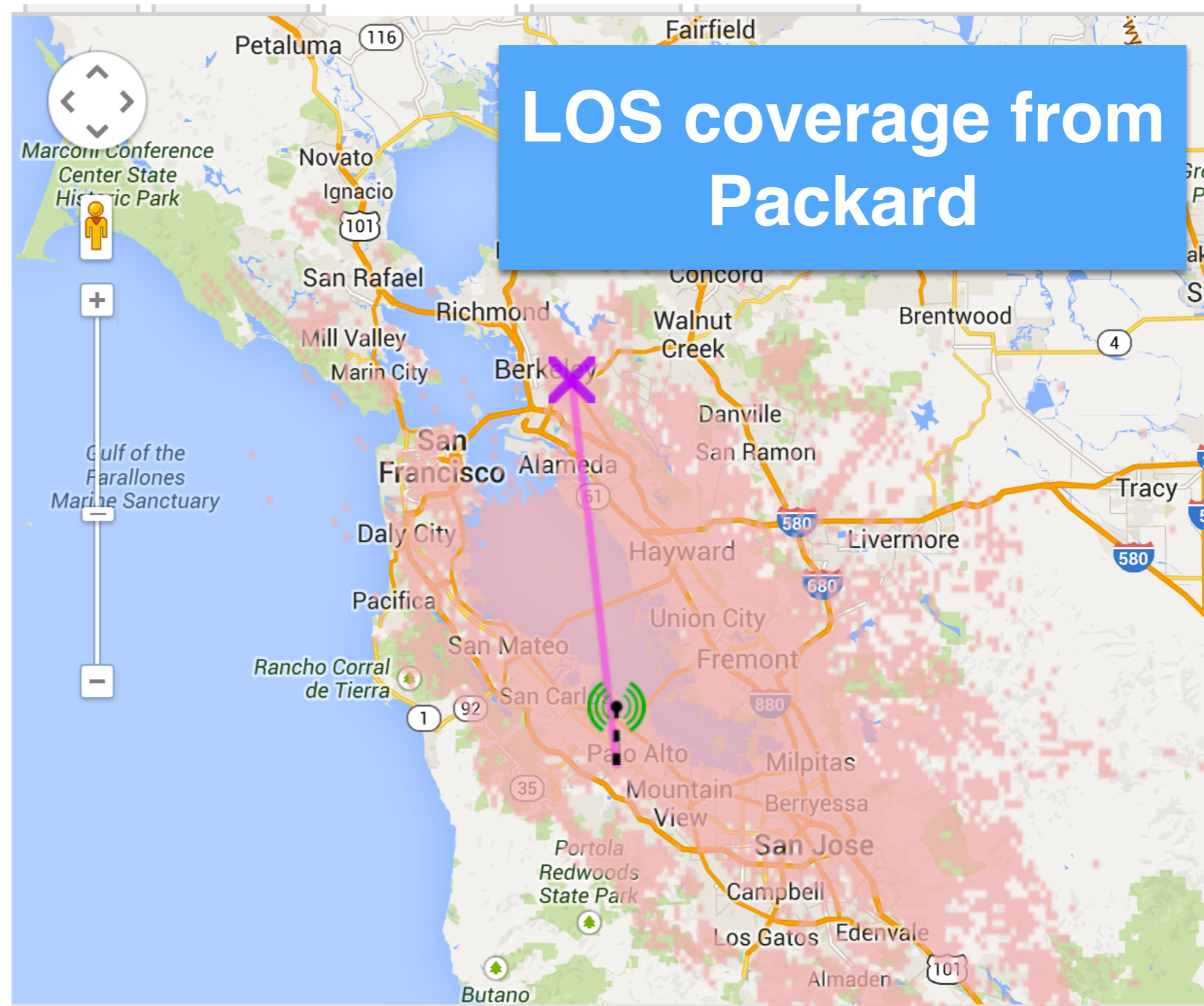
- Information encoded in frequency of carrier
- Wider bandwidth than AM  
Voice 5-15 kHz
- More resistant to propagation effects
- Common for VHF/UHF handhelds and mobiles
- Also digital packet, voice



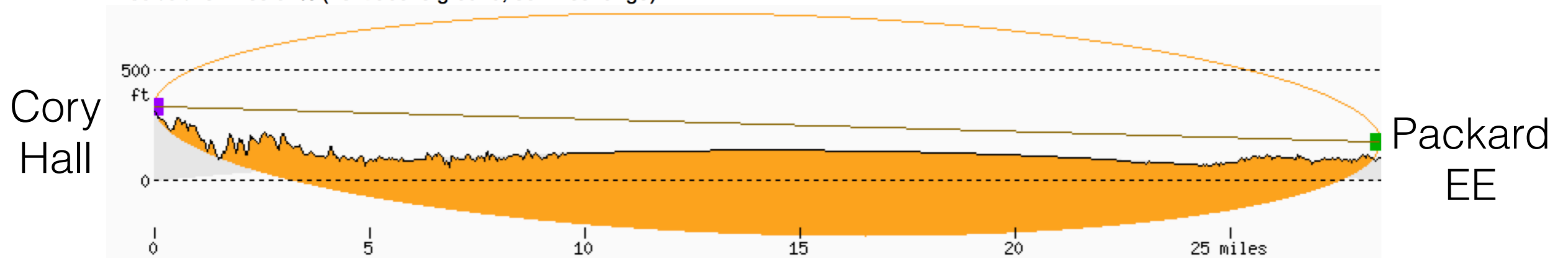
# Line-of-Sight

- At VHF and UHF radio waves effectively travel in straight lines
- Limited by radio horizon
- Slightly refracted by the atmosphere
  - Effective earth radius  $\frac{4}{3}$  the true radius
  - From a radio perspective, the earth is slightly flatter

# Packard EE to Cory Hall, UCB



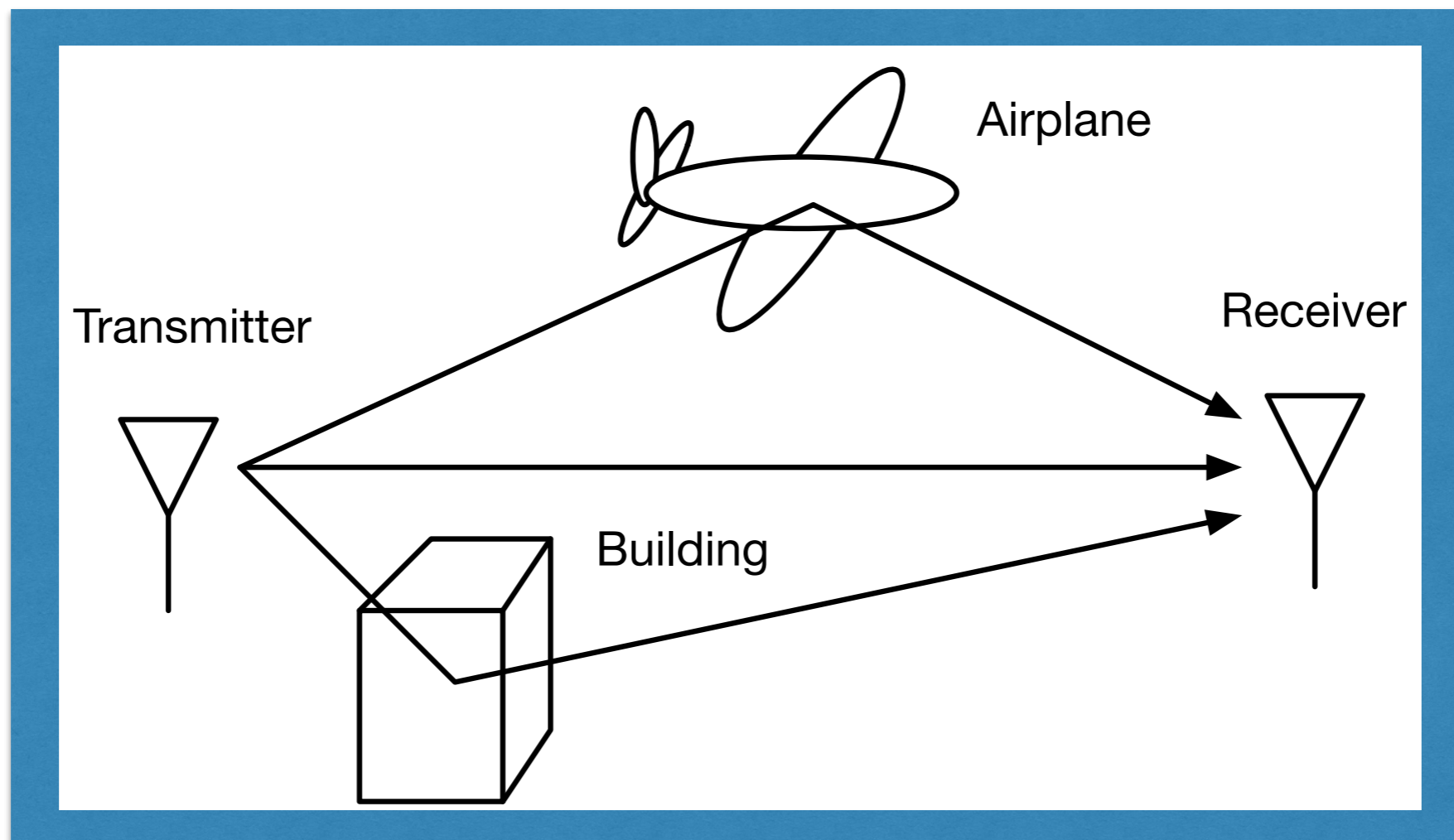
**Packard EE**  
159°/0°/28 miles 61% (75 ft above ground, 50 miles range)



## Propagation Path

# Multipath

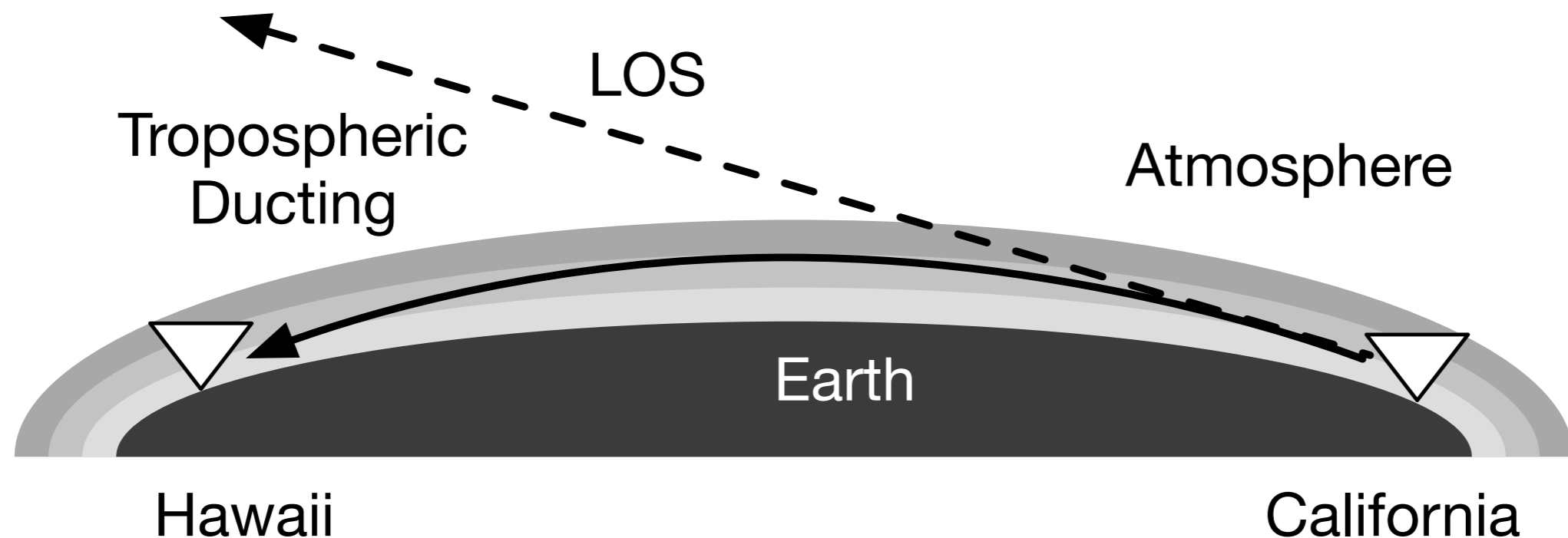
- Radio waves often travel by multiple paths, which can constructively or destructively interfere



- Small changes in location can result in large changes in signal: “picket fencing”

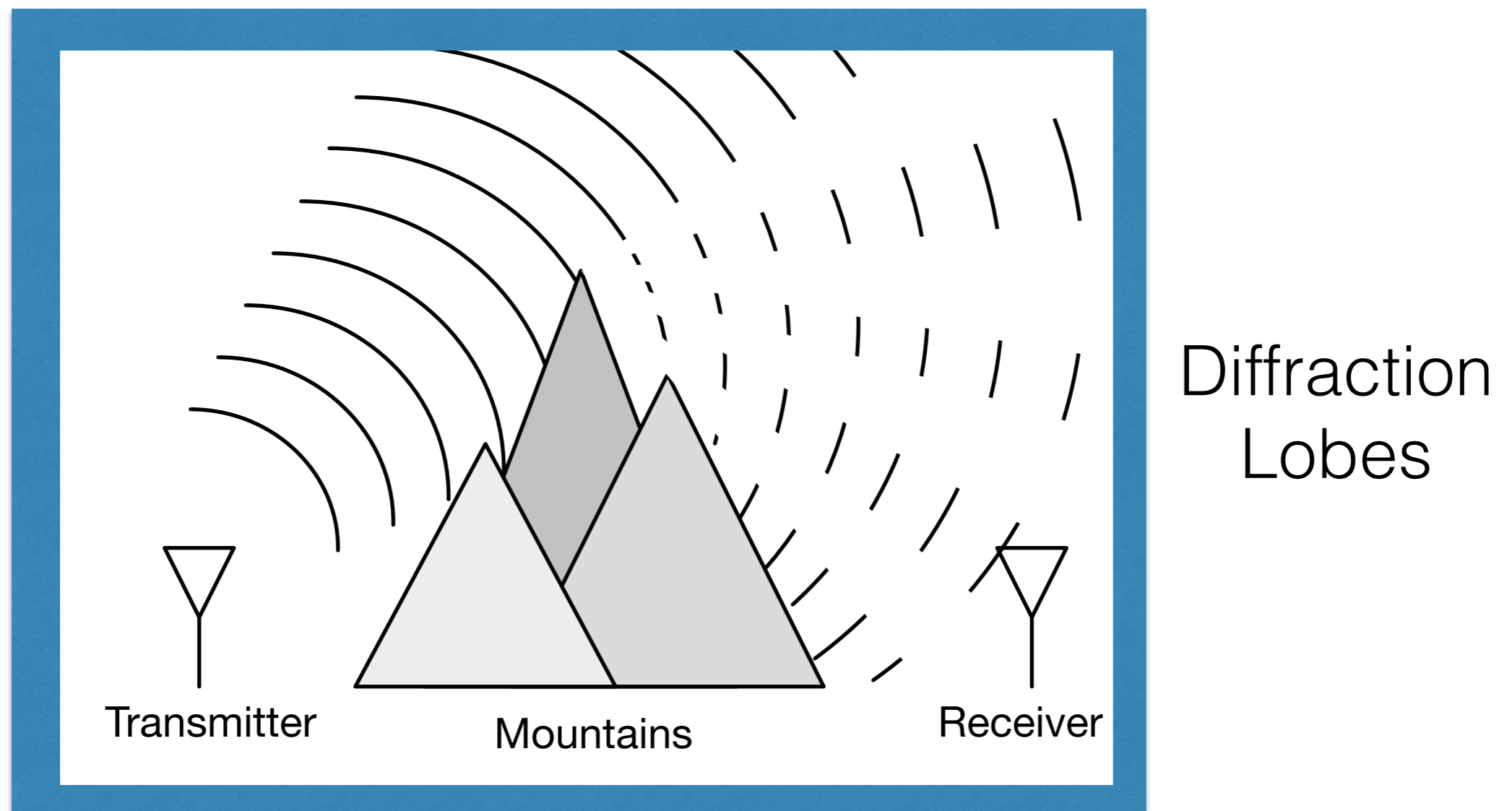
# Tropospheric Ducting

- Temperature and humidity inversions can cause the atmosphere to act as a wave guide
- Frequently in August VHF (like FM radio) is ducted from California as far as Hawaii



# Knife-Edge Diffraction

- Radio waves will diffract from sharp edges, some power will be delivered behind the obstruction



# Handheld Radios

- VHF and/or UHF  
sometimes 220 MHz, 1.2 GHz
- 5 Watts
- Always has FM, may have digital voice and data
- Can be complex to operate  
Every button does three things  
Programmed with a PC, software

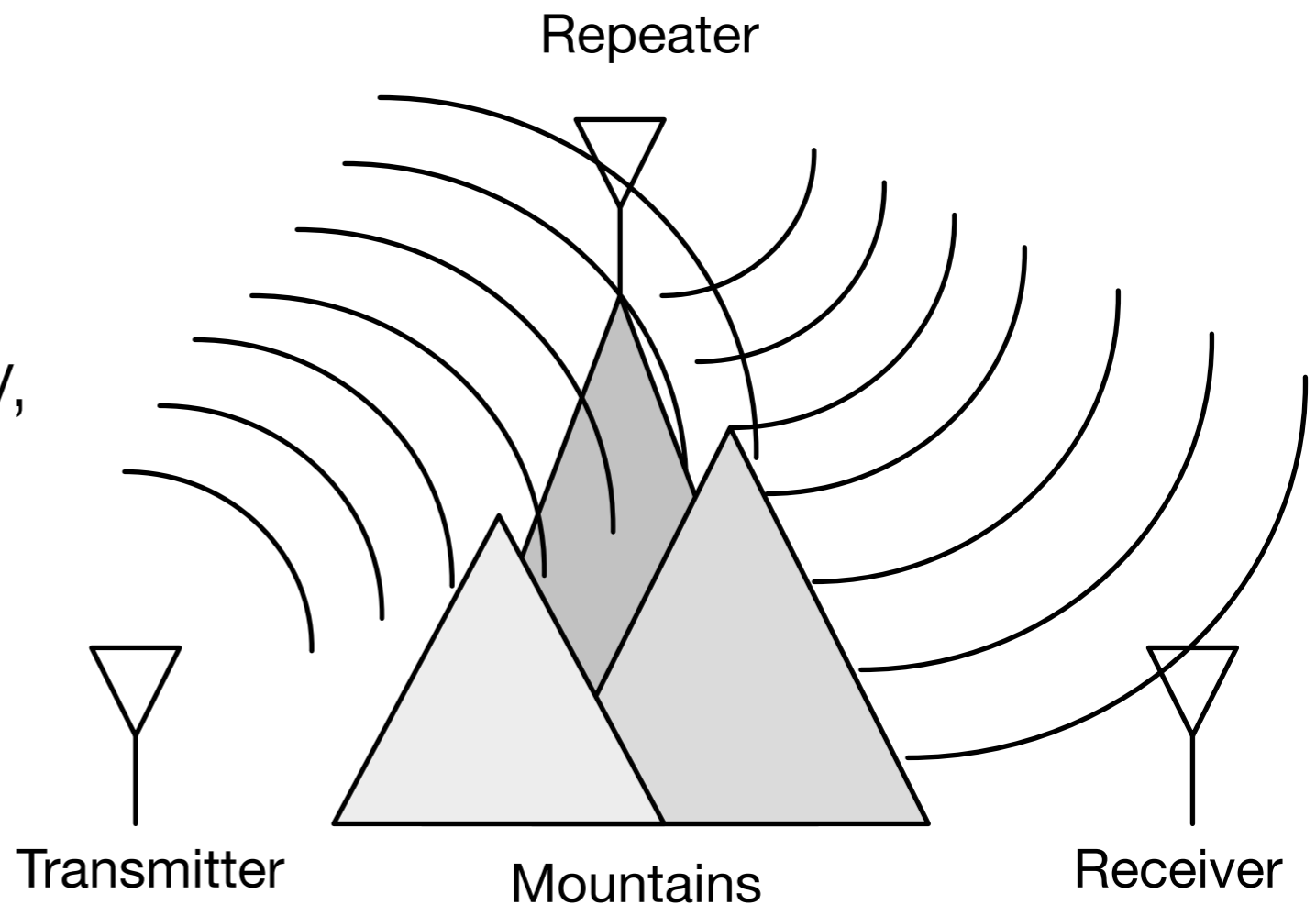


# Connection Methods

- Simplex :
  - You and your contact talk on the same frequency alternately
  - Limited in range (great if you have LOS!)
  - Calling frequencies
- Repeaters :
  - You talk to a powerful radio high on a mountain, it rebroadcasts on a different frequency
  - You can talk to anyone who can see the same repeater (a very long way)
  - Usually need to know an access frequency

# Repeaters

- Repeaters relay signals from radios that normally can't reach each other
- Receives on one frequency, transmits on another
- Repeater split
  - +/- 600 kHz on 2 m
  - +/- 5 MHz on 70 cm
  - Your radio knows!



# Access Tones

- Repeaters don't want to retransmit any signal they hear! If repeaters can hear each other the result could be unstable.
- Repeaters look for an additional tone
  - CTCSS : continuous tone coded squelch
  - PL : Motorola "Private Line"
  - Bursts of codes or tones
  - DCS : Digitally coded squelch

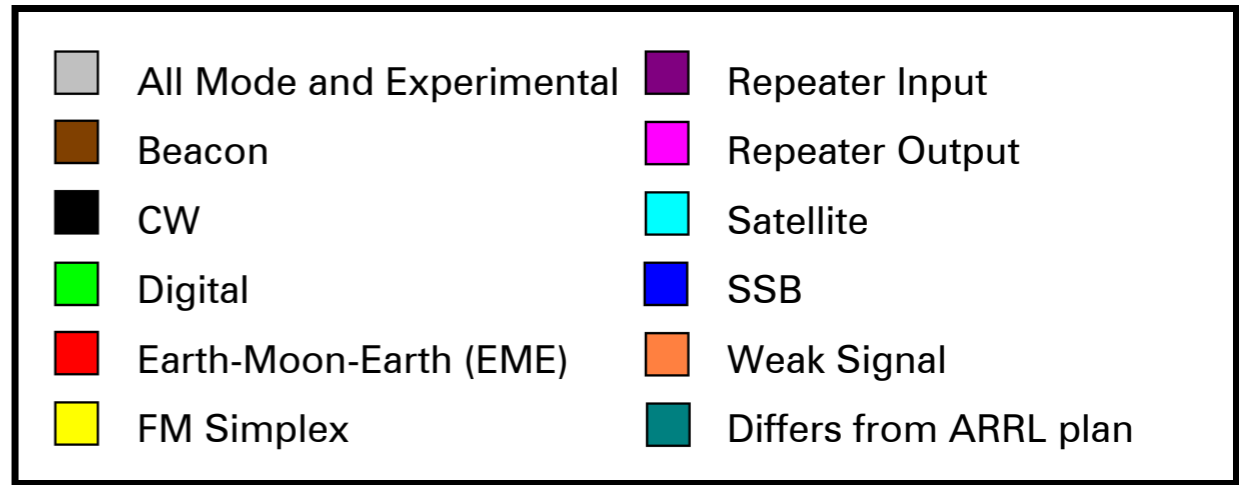
# Repeaters

- Listed in repeater directories, iPhone apps :
  - Repeater output frequency
  - Repeater shift
  - Access frequency (PL = 100, for example)
- Many, many open repeaters out there
- Program local repeaters into your radio

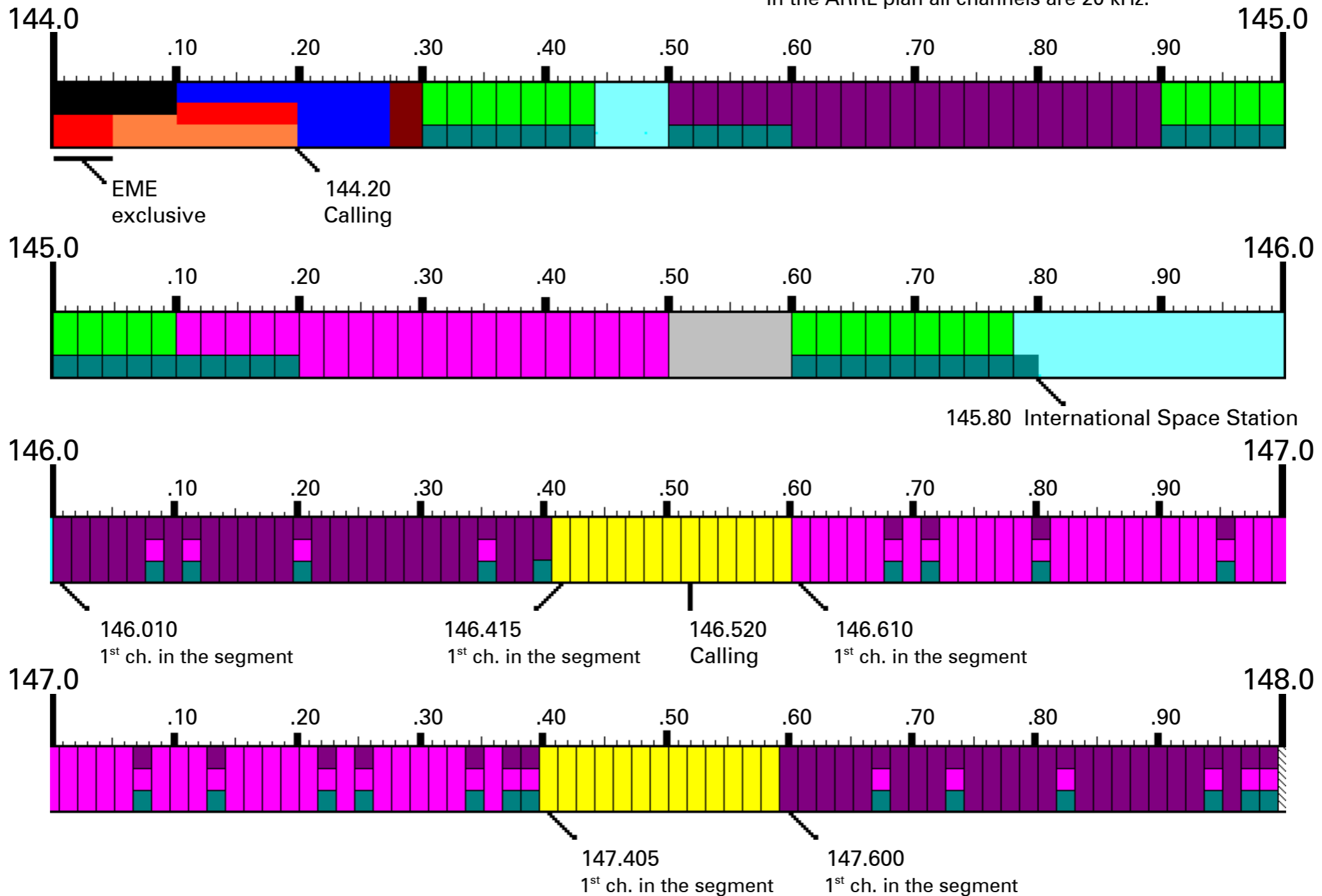
# Band Plans

- FCC doesn't specify what you can do in some part of the amateur bands
- Voluntary agreements define "Band Plans"
- Recommends frequencies for
  - DX (long range)
  - Digital modes
  - Beacons
  - Weak Signals
  - Satellites
  - Simplex
  - Repeater inputs and outputs
  - Control links

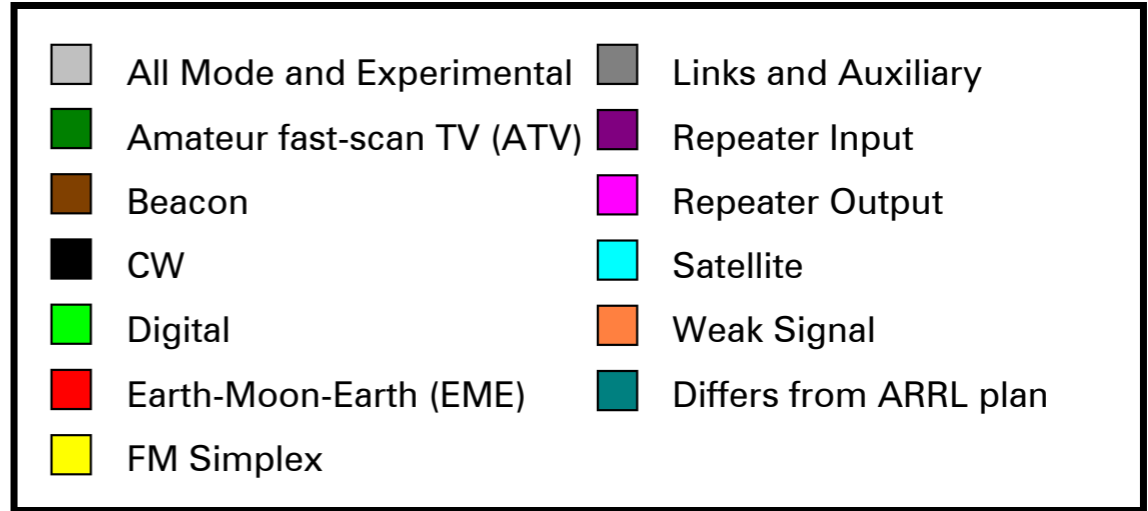
# Northern California 2 m Band Plan



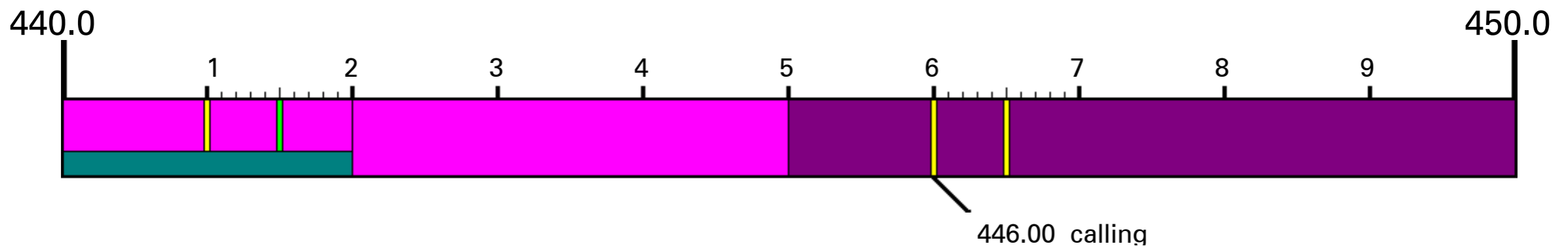
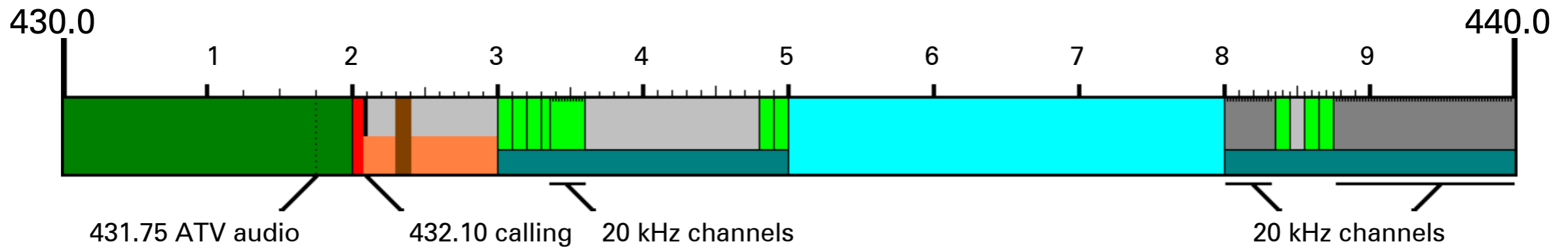
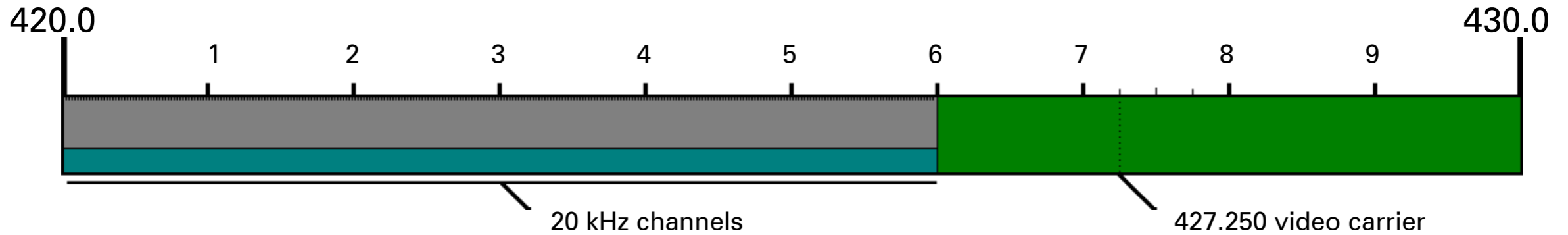
20 kHz channel spacing in 144.0 - 146.0 MHz  
 15 kHz channel spacing in 146.0 - 148.0 MHz  
 In the ARRL plan all channels are 20 kHz.



# Northern California 70 cm Band Plan



25 kHz channel spacing 440.0 - 450.0 MHz  
 Links, Auxiliary, and digital are 20 kHz wide channels except as noted  
 ATV is a single 6 MHz wide simplex channel  
 Weak Signal, Satellite, and All Mode segments are not channelized



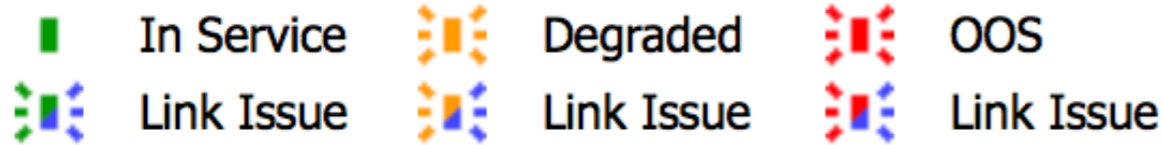
## A few Bay Area 2 m Repeaters












































Frequency MHz/Offset	PL Hz	Call Sign	Location	Repeater Information
145.130 -	127.30	K6EAG	Hayward	Hayward Radio Club
145.150 -	114.80	W6PW	San Francisco	San Francisco ARC
145.170 -	127.30	K6EAG	Sunnyvale	Hayward Radio Club
145.230 -	100.00	N6NFI	Palo Alto	South Peninsula Amateur Radio Klub S.P.A.R.K.
145.270 -	100.00	W6ASH	Mountain View	Southern Peninsula Emergency Communication System S.P.E.C.S.
145.310 -	127.30	KE6ZOY	Santa Clara	<b>IRLP Enabled</b> Node 3488
145.310 -	88.50	WZ6L	Vallejo	<b>IRLP Enabled</b> Node 3545
145.350 -	100.00	AB6CR	Livermore	Livermore RACES Wide Area
145.390 -	100.00	W6DYL	San Jose	South Bay Radio Group
145.430 -	127.30	AD6D	Livermore	Livermore RACES
145.450 -	127.30	K6FB	Los Gatos	Las Cumbres ARC
146.115 +	100.00	AA6BT	San Jose	Silicon Valley Emergency Communications System S.V.E.C.S. Old Call Sign <i>WB6ADZ</i>
146.205 +	103.50	KC6LLI	San Jose	
146.385 +	114.8	W6UU	San Jose	Santa Clara ARA

## Legend



## Status Legend



	System	Freq	Link	Local
   	2 <a href="#">San Francisco</a>	442.075+	162.2	100.0
   	3 <a href="#">Pt. Arena</a>	443.075+	173.8	100.0
   	4 <a href="#">Greenfield</a>	442.075+	167.9	114.8
   	5 <a href="#">Oakland</a>	443.050+	173.8	114.8
   	6 <a href="#">Stonyford/Willows</a>	443.075+	167.9	114.8
   	7 <a href="#">San Jose</a>	443.075+	162.2	123.0
   	8 <a href="#">Tahoe</a>	442.075+	151.4	127.3
   	9 <a href="#">Modesto</a>	442.075+	173.8	123.0
   	10 <a href="#">Santa Cruz/Monterey</a>	443.475+	173.8	123.0
   	11 <a href="#">Walnut Creek</a>	443.475+	162.2	114.8
   	12 <a href="#">Pleasanton</a>	442.075+	156.7	103.5
   	13 <a href="#">Shasta Lake</a>	442.075+	167.9	114.8
   	14 <a href="#">Cisco Grove</a>	443.475+	156.7	100.0
   	15 <a href="#">Coalinga/Fresno</a>	440.750+	162.2	114.8
   	16 <a href="#">Vacaville/Sacramento</a>	440.750+	173.8	100.0
   	17 <a href="#">Sonora</a>	443.475+	151.4	103.5
   	18 <a href="#">Topaz Lake</a>	443.475+	167.9	110.9

# Carla Network

- About 40 networked repeaters across California
- One PL is Local
- Another PL activates the entire networks

# Call Signs

- 1-2 letters, a digit, followed by 1-3 letters
  - Tells a little about your license class
- For the US, the first letter is K, W, or N, or A
- Digit tells where in the US your call sign originated
- Last 1-3 letters identify you

# Phonetics

Letter	Word	Letter	Word	Letter	Word
A	Alpha	J	Juliet	S	Sierra
B	Bravo	K	Kilo	T	Tango
C	Charlie	L	Lima	U	Uniform
D	Delta	M	Mike	V	Victor
E	Echo	N	November	W	Whisky
F	Foxtrot	O	Oscar	X	X-Ray
G	Golf	P	Papa	Y	Yankee
H	Hotel	Q	Quebec	Z	Zulu
I	India	R	Romeo		

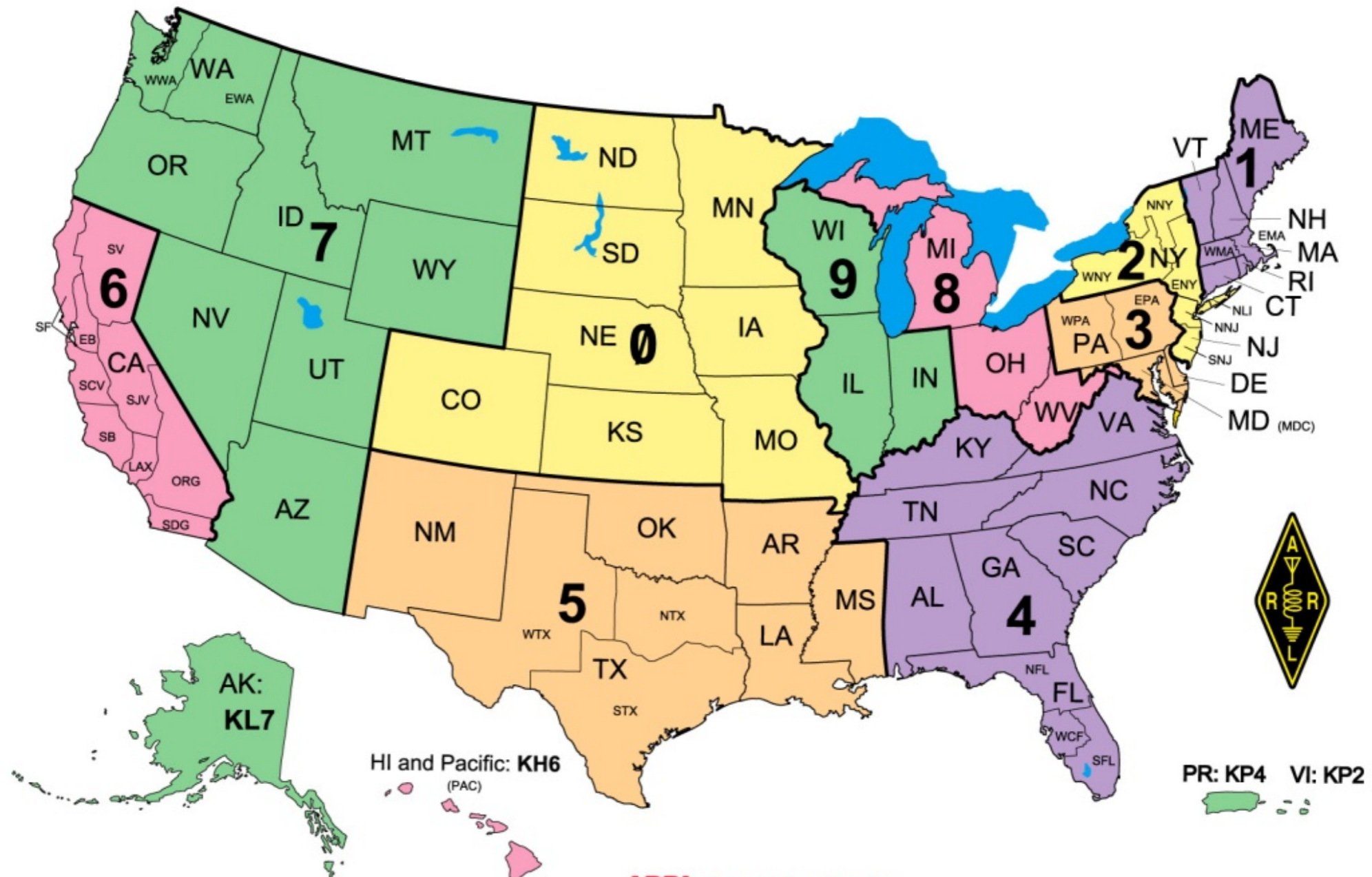
AG6WH : Alpha Golf Six Whiskey Hotel

# Typical Call Signs

- Technician class (2x3, Group D)
  - KK6GAF
- Extra class (2x2, Group B)
  - AG6WH
- Vanity call signs
  - Many 2x2's (Group B, General) and 1x3's (Group C, Tech) available
  - 1x2's and 2x1's are harder to come by (Group A, Extra)
- Special events have 1x1's

# Call Signs

Middle digit tells you where the call sign was issued



Which of the following is a valid call sign for a Technician class amateur radio station? (T1C05)

A. K1XXX

B. KA1X

C. W1XX

D. All of the above

Which of the following is a valid call sign for a **Technician** class amateur radio station? (T1C05)

**A. K1XXX**

B. KA1X

C. W1XX

D. All of the above

# Vanity Call Signs

- You can make up your own call sign
  - Must have the right number for your district
  - Web sites to help you find one that is free
- Apply on the FCC web site, for free
- My wife is Kim B Pauly, so she has KB6PAU
- My friend Miki works in MRI, so he is KK6MRI

# Signal Report

- Verbal: “you are just barely getting into the repeater...”
- RST : Three numbers
  - Readability 1-5
  - Signal Strength : 1-9
  - Tone : 1-9 (for CW)
  - Best is 599
- “Q” System
  - Barely understandable (1) to perfectly readable (5)

# Calling Protocol

- Listen first to see if the frequency is free. Press the small, lower button (mon) to do this.
- Push the PTT button (big middle button), the red light goes on, wait a second, and talk into the microphone
- Identify with your call sign every ten minutes, and when signing off. I'm AG6WH, or alpha-golf-6-whisky-hotel
- If you are looking for someone to talk to say something like "CQ CQ CQ this is AG6WH", or "AG6WH Monitoring"
- When you are done, tell everyone that the frequency is open by saying "AG6WH Clear", or "AG6WH 73"

# Basic Regulations

# Amateur Radio (Official)

- Amateur (or Ham) Radio is a personal radio service authorized by the Federal Communications Commission (FCC).
  - To encourage the advancement of the art and science of radio.
  - To promote the development of an emergency communication capability to assist communities when needed.
  - To develop a pool of trained radio operators.
  - To promote international good will by connecting private citizens in countries around the globe.

# Licensing Authority

- Federal Communications Commission (FCC)
- Amateur Radio operations covered by FCC rules published in Part 97 of Title 47 – Code of Federal Regulations.
  - Use “Part 97” for short
- Others are Part 90 (commercial), Part 95 (CB, MURS, FRS), and Part 15 (WiFi, low power, anything that radiates RF).

# The Amateur License

- No age limit or citizenship restrictions.
  - One exception – foreign representatives.
- License actually contains two parts.
  - Operator License.
  - Station License (the Call Sign).
- Three levels of operator privileges:  
Technician, General, Amateur Extra.

# Exam

- Multiple choice, multiple exams, multiple levels
- Run by Volunteer Exam Coordinators (VEC)
  - At least 3 Volunteer Examiners (VE's) of higher class
- Usually \$15 to take all three levels
- You can operate when your call sign appears in the FCC data base ([www.wireless.fcc.gov/uls](http://www.wireless.fcc.gov/uls)) and you have your call sign. Usually just a few days.

# License Term

- The license is \$35 and good for 10 years.
  - Renewable within 90 days of the expiration date (2 year grace period).
- Some personal identification information is required.
  - Tax ID (Social Security number).
  - Current Mailing Address.
  - Federal Registration Number (FRN).

# Responsibilities

- Prevent unauthorized operation of your station.
- Provide personal information as required – keep a current mailing address on file.
- Make your station available for FCC inspection upon request.

# Basic Principles

- You can't make money from transmitting on amateur radio frequencies
  - Limited ads, no music, etc
- You should be polite and cooperate with others
  - Minimum power necessary
  - Use accepted frequencies appropriately
  - No encryption
  - Amateur radio is basically self regulated

Which of the following is a purpose of the Amateur Radio Service as stated in the FCC rules and regulations (T1A01)

- A. Providing personal radio communications for as many citizens as possible.
- B. Providing communications for international non-profit organizations
- C. Advancing skills in the technical and communications phases of the radio art
- D. All of these choices are correct

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What agency regulates and enforces the rules for the Amateur Radio service in the United States? (T1A02)

A. FEMA

B. The ITU

C. The FCC

D. Homeland Security

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A. FEMA

B. The ITU

**C. The FCC**

D. Homeland Security

Under which of the following circumstances are one-way transmissions by an amateur station prohibited?

- A. In all circumstances
- B. Broadcasting
- C. International Morse Code Practice
- D. Telecommand or transmissions of telemetry

Under which of the following circumstances are one-way transmissions by an amateur station prohibited? (T1D02)

A. In all circumstances

**B. Broadcasting**

C. International Morse Code Practice

D. Telecommand or transmissions of telemetry

Under what conditions is an amateur station authorized to transmit music using phone emission? (T1D04)

- A. When incidental to an authorized retransmission of manned spacecraft communications
- B. When the music produces no spurious emissions
- C. When the transmissions are limited to three minutes per hour
- D. When the music is transmitted above 1280 MHz

Under what conditions is an amateur station authorized to transmit music using phone emission? (T1D04)

- A. **When incidental to an authorized retransmission of manned spacecraft communications**
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In which of the following circumstances may the control operator of an amateur station receive compensation for operating that station? (T1D04)

- A. When the communication is related to the sale of amateur equipment by the control operator's employer
- B. When the communication is incidental to classroom instruction at an educational institution
- C. When the communication is made to obtain emergency information for a local broadcast station
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# Next Time

- Radio Signals and Fundamentals
- Basic Operations