Radio Merit Badge—Part 1

November 12, 2005

Presented by

John Chamberlain AC5CV

Bill Feltenberger KD5UEW

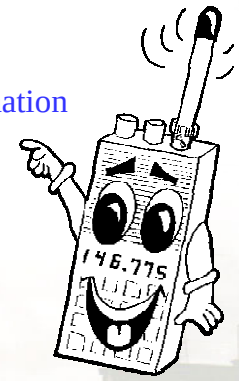
What You'll Learn This Week…

1. What is radio? How does it work?
2. Phonetics: a funny way to talk
3. How far can I talk with radio?
4. The rainbow of radio (frequency)
5. Main parts of every radio station
6. The most important part—and you can build it!

11

What is Radio?

- Communication
- Sending and receiving information
- From one place to another
- Electronically but…
- ***Without wires!***



Two Kinds of Radio

11

- "One way"
- "Two way"

Broadcast Radio (One-way)

11

- Directed to the public: anyone listening!
- Can be *commercial*–goal is to make money (news, sports, music)
- Might also be non-commercial (school, Voice of America, religious)
- **One-way communications:**

  Send only

Two-way Radio

11

- For fun, general interest, or even "help"
- Generally **non-commercial** (not for profit)
- Includes CB radio, FRS, and amateur radio, fire and police departments, and so forth
- Two-way communications:

  1. **Send** (transmit) and…
  2. **Receive** (listen)

- All **Amateur** radio communications must be two-way.

Call Signs

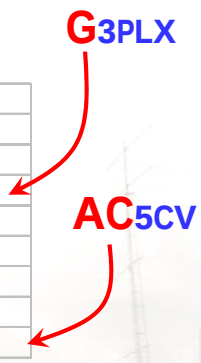
42-43

- "Call signs" identify the station and are **required** by law.
- Examples of **broadcast** call signs: KWTX, KCEN, KRZI, WWV
- Examples of **amateur** call signs: AC5CV, KD5UEW, W1AW
- **Amateur radio call signs** can tell you **where** in the world a station is licensed.

Amateur Call Signs Around the World

42-43

4X, 4Z	Israel
9K	Kuwait
DU-DZ	Phillippines
G, GB, GX	England
JA-JC, JE-JS	Japan
OA - OC	Peru
SI - SM	Sweden
VA-VG, VO, VX-VY, XJ	Canada
W, K, N, A	United States



Using Phonetics

44

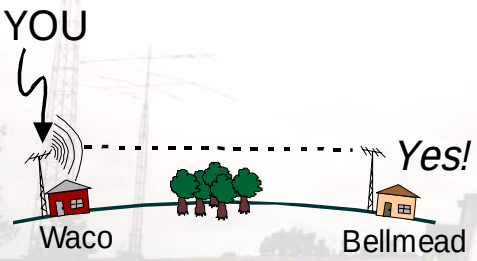
- Use standard words for letters
- Makes spelling clearer—even for foreigners
- Alfa, Bravo, Charlie, Delta, Echo, Foxtrot, Golf, Hotel, India, Juliet, Kilo, Lima, Mike, November, Oscar, Papa, Quebec, Romeo, Sierra, Tango, Uniform, Victor, Whiskey, X-ray, Yankee, Zulu.

A C 5 C V

14

How Radio Waves Travel

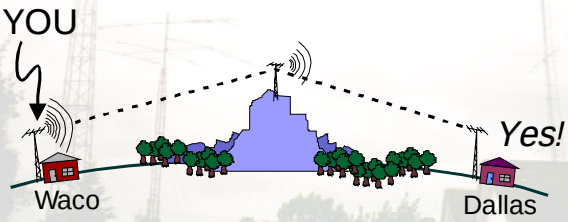
- Line-of-sight: the antennas can "see" each other. Your radio signals are heard!



14

How Radio Waves Travel

- If a hill or mountain is in the way, or the station is too far for line-of-sight, a "repeater" mounted up high can relay your radio signals.



14

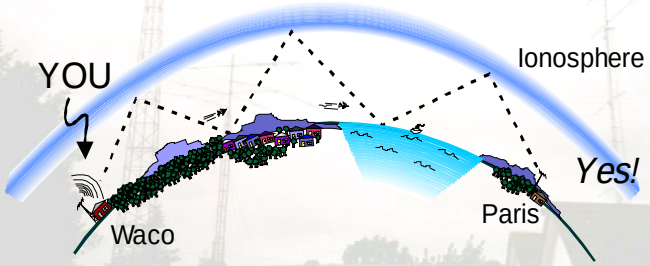
How Radio Waves Travel

- Some radio waves can reflect off the ionosphere (about 100-200 miles up) and travel hundreds of miles.

How Radio Waves Travel

14

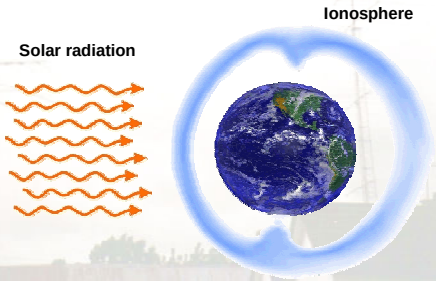
- Radio waves can even reflect more than once and sometimes travel long distances around the world!



How Radio Waves Travel

14

- Signals can also be relayed by satellite or even reflected off of the moon!
- Reflection off the ionosphere is affected by radiation from the sun, so radio operators monitor the solar conditions, and the time of day.



You Can Use Broadcast Stations To Help Predict Solar Conditions

15

- WWV in Colorado and WWVH in Hawaii broadcast on several frequencies.
- Listen for these stations and you can tell how good signals from those regions will be.
- WWV reports the time Coordinated Universal Time (UTC), also known as Greenwich Mean Time (GMT) or Zulu (Z).
- Radio operators always use **UTC** or **Z**.
- For example, at 1200Z, it is 0600 CST (in Waco).

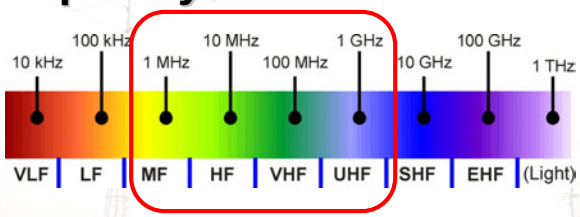
16

Frequency

- Frequency is measured in a unit called *Hertz (Hz)*, or "cycles per second"
  - Grandfather clock: ½ Hz
  - Small pendulum clock: 1 Hz
  - Pedaling a bicycle: 2 Hz
  - Low string on a bass guitar: 41 Hz
  - High string on guitar: 330 Hz
  - Radio station KRZI: 1,230,000 Hz (or 1230 **kilo**Hertz)
  - TV station KWTX: 195,000,000 Hz (or 195 **Mega**Hertz)
  - Microwave oven: 2,450,000,000 Hz (or 2.45 **Giga**Hertz

16-17

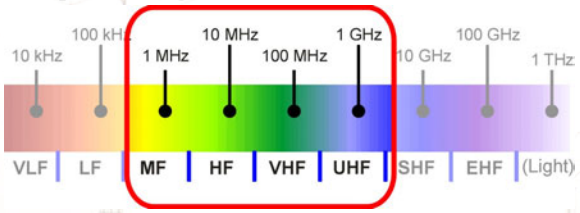
Frequency



- Remember this:
  - ***kilo-*** means 1,000 (thousand), as in **k**Hz
  - ***Mega-*** means 1,000,000 (million), as in **M**Hz
  - ***Giga-*** means 1,000,000,000 (billion), as in **G**Hz

16-17

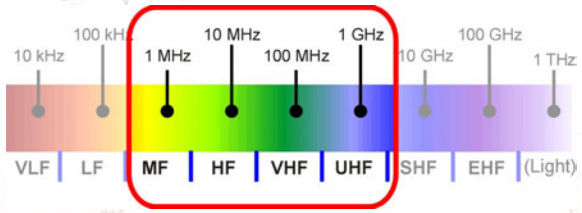
Frequency



- MF (Medium Freq.): 300 kHz – 3 MHz
- HF (High Freq.): 3 MHz – 30 MHz
- VHF (Very High Freq): 30 MHz – 300 MHz
- UHF (Ultra High Freq): 300 MHz – 3 GHz
- "Microwaves": generally above 500 MHz

16-17

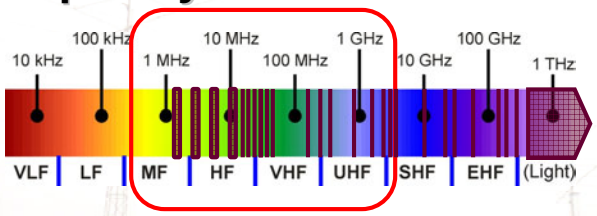
Frequency



- Commercial AM: 535 kHz – 1.7 MHz
- Shortwave, Amateur: 3 – 30 MHz
- CB radio: 27 MHz
- VHF-TV: 54 – 88 MHz, 174 – 220 MHz
- Commercial FM: 88 – 108 MHz
- Cellular phones: 824 – 849 MHz
- Waco Police: 856 – 860 MHz
- Air Traffic Control radar: 960 MHz – 1.2 GHz

52

Frequency



- Amateur radio is allowed to transmit at 27 specific “windows” throughout the spectrum.

16-18

Other Radio Stuff

- Amateur radio began with HF frequencies.
- But now includes VHF, UHF, and above!
- HF radio waves can travel around the world.
- When an American operator makes a contact across the ocean, we consider that a distant contact, or “**DX**.”
- DX contacts are thus usually outside the U.S.
- In contrast, a contact within the country is considered “**Local**.”

16-18

Other Radio Stuff

- Since radio waves travel around the world, we need international rules and agreements.
- "**Band plans**" are agreements on how to use all the available frequencies in a friendly way.
- The ***International Telecommunications Union*** (or **ITU**) sets up "band plans" **internationally**
- The ***Federal Communications Commission*** (or **FCC**), sets up the band plans and rules in the U.S.

Transmitting

- A sudden "rush of electricity" creates a "shock wave" of electric field.
- Like a ripple radiating outward in a pond.
- A radio **transmitter** makes the "rush of electricity" happen over and over—at high frequencies. (Remember? ***Mega***-hertz!)
- The "ripples" thus spread out, pulsing at the same high frequency.

How Do You Send Information?

- Is it On or Off?
- Is it switching On and Off?
- If switching On and off, is it fast or slow?
- Is it switching fast enough (like a guitar string) to make a tone?
- …or even a mixture of lots of tones… like a human voice!

Receiving

- A radio receiver detects the ripples of electric energy at those high frequencies.
- You "tune the receiver" to match just one frequency (ignoring all others).
- It's like blowing across a bottle: you are making thousands of frequencies of noise across the bottle opening, but just **one frequency** (one tone) starts to "sing."

That's All for Today!

Next week we'll cover:

- Making a radio station
- Antennas—you can make them!
- Safety first! Radios can hurt you or others!
- Drawing pictures of electric circuits
- What can Amateur Radio Operators do?
- Code words we use
- Different kinds of radios