Radio Merit Badge

Module 2

Frequency

If you want to learn about radio systems, you should first understand the concept of "the frequency of a wave".

Frequency is simply how often something happens.

Heinrich Rudolf Hertz was a German physicist. In 1888 he discovered the radio waves previously predicted by Maxwell's equations. He also proved that light is a kind of electromagnetic wave. The unit for frequency is named after him.

A frequency of 1 hertz or 1 Hz means that something happens once a second. Tap out a 1 sec pulse on the table.

MAKING WAVES – Run and Ropes

Repeating waves are like running around a circular track at a fixed speed. If we measure the time to make a complete circle, this is related to frequency. Example If we run around once in 2 minutes,

Q. how many times per second are we going around?

Answer .. One half circle per minute or 1 circle in 120 seconds. This is only 0.008333 Hz or 8.3 milliHertz or mHz. (small m). A <u>very low frequency</u> in Hz.

If you make a video and measure how much left or right of the center you are in each frame. Your position looks like the next slide
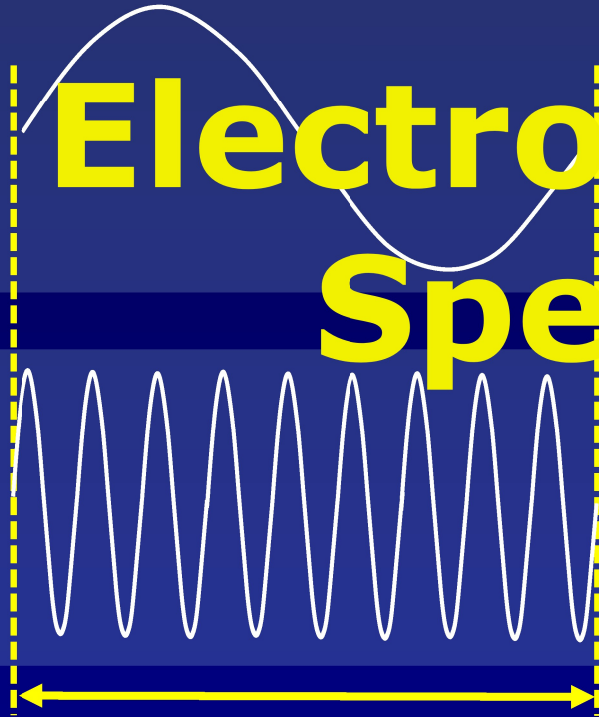
1 2 3 4 5
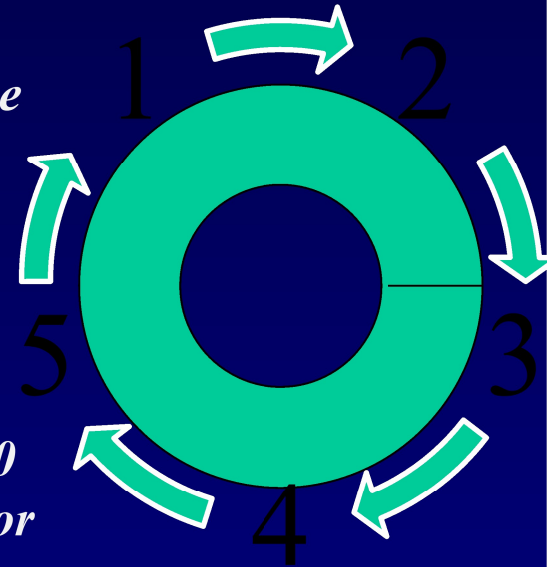
Frequency

Electromagnetic Spectrum

1 cycle per second

= 1 Hertz

= 9 Hertz

1 second

Musical Waves - a bit faster

Musical notes we hear is air moving back and forth hundreds or thousands of times per second. The note A (Do Re Mi...La) vibrates at 440 Hz.

If something vibrates at 1000 times per second, we call that a KiloHertz or KHz.

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p=yhs-3&hspart=iba&p=1+khz+test+tone&vm=r&type=dkff_9317
_FFW_ZZ#id=2&vid=63570a16bdfe15da54c0e58998f4e623&acti
on=click

RADIO WAVES

The only radio waves we can "see" are light beams. Most radios use antennas and we can't see those waves but we can measure them.

Radio waves are a combination of electrical and magnetic energy that vibrate at some frequency. The ones that vibrate *millions of times per second* *are what was called* <u>*short wave radio*</u> *and we call a vibration of 1 million per second a* *MegaHertz or MHz.*

We no longer call then SHORT WAVES because we use much shorter waves in radios now. More on that next…

Once started, radio waves are always in motion.

Waves don't only vibrate with time, they also travel in space. If you clap your hands or see a lightning bolt, the sound takes some time to reach you. This speed in 1 Mach or about 767 miles per hour. Pretty fast but nothing like the speed of radio waves that travels at light speed.

Q: Does anyone know the speed of light ?
A.   186000 miles per hour or about 300,000,000 meters per
     sec or about 1 foot in a billionth of a sec.

The number 300 is a really handy to remember for radio.

RADIO WAVELENGTH

*Waves can be a bit complicated because while the intensity of waves are changing at any one place, we could also track the position of the **same** intensity as it moves. This is what we mean by the SPEED of a RADIO WAVE. Let's pick the top of the wave as our measuring point. While there are many tops, we will try to track one of them as it moves.*

Suppose we have a wave that vibrates 1 million times a second or 1 MHz. It comes back to the same intensity one millionth of a sec later.

If it is travelling 1 foot in a billionth of a sec, it would travel 1000 ft (1 billion is 1000 times 1 million) before it gets back to the same intensity. **This distance is called** WAVELENGTH. **So we now know that** the WAVELENGTH of a 1 MHz radio signal is 1000 ft or about 305 meters.

For Math Wizards..
Wavelength and Frequency

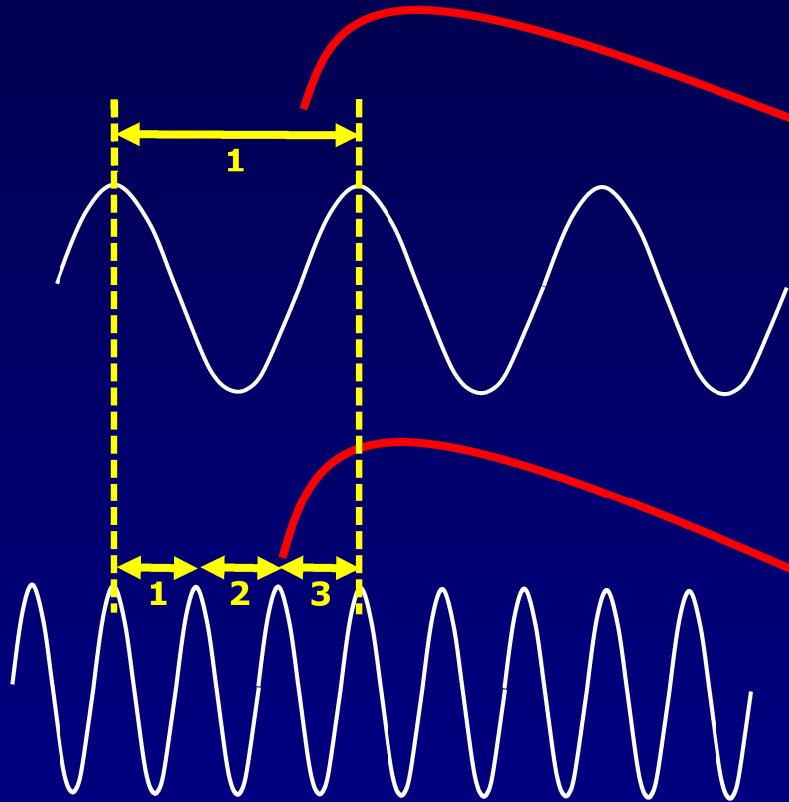*The formula is WAVELENGTH equals 300 divided by the Frequency in MHz.* $W = 300 / F$

Also --

FREQUENCY in 1 million cycles per second is 300 divided Wavelength in meters. $F = 300/W$

Same formula using 300 again.

Wavelength

- **Longer wavelengths**
- **Lower frequencies**
- **Lower energy**

- **Shorter wavelengths**
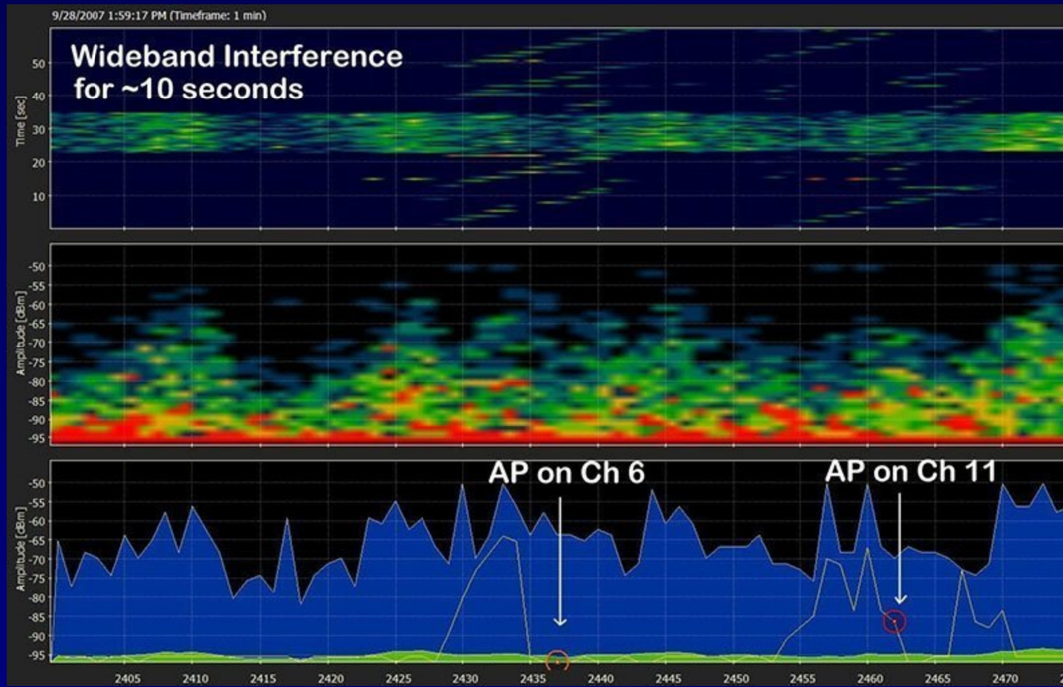- **Higher frequencies**
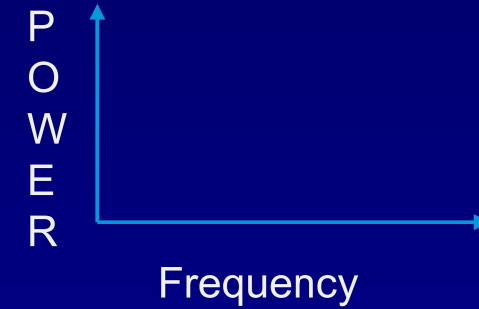- **Higher energy**

What is Wavelength?

https://www.youtube.com/watch?v=zLmAaAx1tUQ&t=100s

Spectrum Analyzers

Waterfall- Power is the color

Time → Frequency

POWER → Frequency