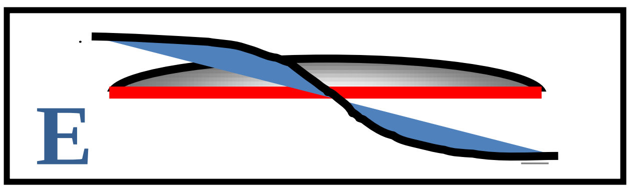
The Radio Hotel – The Antenna - Part 3 by W5RH

Resonance and Standing Waves and Feed Z -- Oh, My!

When talking antennas you need to think impedance. As you know, impedance is specified in 2 ways –
1) as a phasor with amplitude and angle, or 2) as an R (resistance) value and a j (reactance) value. Resistance is just that -- resistance, but reactance can be either capacitive xC or inductive xL. Knowing this then: resonance is the point where an antenna feedpoint exhibits close to zero reactance, neither capacitive xC or indutive xL. At resonance, the feedpoint is close to being "purely" resistive. The antenna is neither too short nor too long. On either side of resonance you have a feed Z that is resistive with the addition of inductive or capacitive reactance….too long or too short, respectively.

For example: a center fed dipole that is too short for a specific frequency will exhibit a feed Z with a resistive and a capacitive reactive feed Z = R –jxC. We can lengthen the wire and cause it to be resonant. Then, if we extend the wire even further it will be reactive again and we'll have an R + jxL feed Z. You can see that for a fixed frequency we have to vary the length of the wire – called "tuning". An antenna does not have to be spot on resonant, it can be off resonance quite a bit and it will still work, but more on this later.
OK, all well and good so far, but "resonant" to what? Ham's use radio frequencies that relate to wavelength and wavelength relates to physical wire length. The shortest single wire that is resonant is one half a wave length long – remember, 468/F MHZ is the length formula for a one half wave length wire (180 electrical degrees). At this one half wavelength, the sinewave charge (voltage) flowing from the transmitter travels from the feedpoint to the end of the wire then reflects back again and it arrives at the exact degree of the sinewave as it came from (plus 180 degrees). Totally in sync, like a flywheel effect. This happens over and over and over and it generates a "standing wave" of voltage and current. (see cartoon). Google Standing Wave Antenna[1]



Standing waves of voltage E and current I

From the cartoon you can see how the voltage and current standing waves relate: current is maximum in the middle and voltage is maximum at the ends. This relationship correlates with the value of the Feed point – it follows Ohm's Law E/I = R.

- -- If the feedpoint is located in the middle of the resonant wire (center fed) where voltage is low and the current is high - the feed Z is low (i.e. 50 ohms).
- -- If the feedpoint is located at the end of the wire (end fed) where the voltage is high and the current is low - the feed Z is high (i.e. 1K ohms).

As you move the feedpoint out from the center to the end, the feed Z increases. For example: on an off-center fed dipole, the feedpoint is, typically, 1/3 the distance from the end and the fee Z is approximately 400 ohms.

Building up your knowledge of how antennas work and their characteristics will allow you to better understand antenna systems and then make the best decisions as to the antenna type to apply to your particular base, portable or mobile situation. **Next time – Polarization and Radiation patterns.**

Notes: 1-- Standing Wave antennas versus Traveling Wave antennas (Rhombics, Beverages, etc.) – Google the difference

*The purpose of **The Radio Hotel** is to give you a practical kickstart into exploring the workings of antenna systems. It is a series, so go back and read the previous columns to get the whole picture, as one month relies on the previous month's information . Google the buzz words and find out what they mean. Read up on antenna system theory to see how it all works together. You will be glad you did.*