The Radio Hotel –Matching within the Antenna System   Rick – W5RH

The whole premise of paying attention to the antenna system's SWR is to lessen the losses within the antenna system and, therefore, provide the maximum amount of power out (and reciprocally, reception strength in).

On most Ham Radio antenna systems you have an antenna that is nominally 50 ohms feed Z, coax that is nominal 50 ohms characteristic Z and a transceiver that has been designed to output into a 50 ohm system. All components are then closely matched, providing a nominal 1:1 SWR. Recall that, even in a perfectly matched condition that there are "matched" system losses. For one, coax is inherently lossy. Just how lossy is dependent on the coax type. *(Google: coax attenuation chart W4RP)*

As seen last month (TRH Sept 2014), even within the confines of 80 Meters the SWR can vary widely. Also, depending on the antenna feedpoint location the SWR can be very high. For example, with a ½ wl end fed wire, the antenna feed Z is greater than 1K ohms creating a 20:1 SWR.   Another example is a center fed, multi-band dipole that is used on the second harmonic or other non-resonant bands. The feed Z could vary between 10 ohms and 2K ohms and be very reactive, hence generating a 50 ohm SWR of greater than 40:1.   For all of these examples, some type of impedance "matching" is required.

Matching can be provided anywhere along the TL (transmission line).   This matching is accomplished by a network of lumped inductive and capacitive components. *(Google: impedance matching).* The network could be a manually adjusted L, Pi or T network or it could be a fully automatic ATU "Antenna Tuning Unit" (or Coupler) operating remotely at the antenna feedpoint. (*Google: antenna tuner and antenna coupler*) Matching right at the antenna feedpoint is best, as it causes the TL to see a load that is matched to its' characteristic impedance (i.e 50 ohms for coax, 600 ohms for open wire line, etc.), so maximum transfer of power happens and only the matched TL loss is incurred (plus a bit of loss within the matching network itself).

You could move the matching network down the TL toward the transmitter to some physically convenient point (like on the ground) or, as most Hams do, move it all of the way back to shack end of the TL.   But if you do, then the effect of the feedpoint mis-match will cause increased loss due to a higher SWR on the TL between the matching network in the shack and the antenna feed point at the other end of the TL.   (Note: This is why Hams, implementing this "in shack" configuration, will use open wire or parallel wire transmission line between the ATU and the antenna – open wire line has much lower loss than coax.)

If the ATU provides a match of 1:1 right at the transmitter, then the transmitter will see 50 ohms and it will dump full allotted power into the matching network, which will then transfer most of that power into the TL (some loss in the matching network will occur). This power will then travel on the TL to the antenna, see the feedpoint mis-match and reflect a portion of the Forward power (see TRH May). The Reflected wave heads back to the matching device in the shack and is then, due to complementary wave mechanics, reflected back toward the load. All the while, losses will occur on both the forward and reflected waves traveling back and forth, hence the increase in loss, over the matched TL loss, when a greater than 1:1 SWR is on the TL. Matching in the shack is common practice and can be made efficient with the use of the proper TL/feedline and the properly sized matching network.

Understand antenna system characteristics (i.e. antenna feed impedance and matching network type and location within the system) and their affect on TL losses is most important for implementing the best system for your particular situation.   This is what **The Radio Hotel** is trying to accomplish; to provide you with a baseline knowledge about the TL--transmission line. TL's can be a bit of a gray area for some Hams. Let's hope after the past few months that it is less gray.

Next month -- The last piece to the SWR/Matching puzzle.
*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.*