A METHOD TO CONNECT CROSS-YAGIS GETTING 4 DIFFERENT POLARIZATIONS

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For those who have their antennae rather near their radio shacks, this seems to be a good solution for getting the 4 possible polarizations using two VHF/UHF crossed-yagis (on the same boom or not).
Normally, to do that connection, we have to use pieces of 1/4 wavelength (odd multiples) of 73 Ohm lines and relays or some other remote control system if we want to change from the original wave polarization.
Here I describe a system that only uses, connected to the antennæ, 53 Ohm coaxial cables and all the polarization switching is done in the shack, with no remote control or relays. The price one pays is that we have to use two coaxial pieces from the shack to the antennæ.
The drawing, to be easily read, represents physically separated yagis but they may be assembled on only one boom.

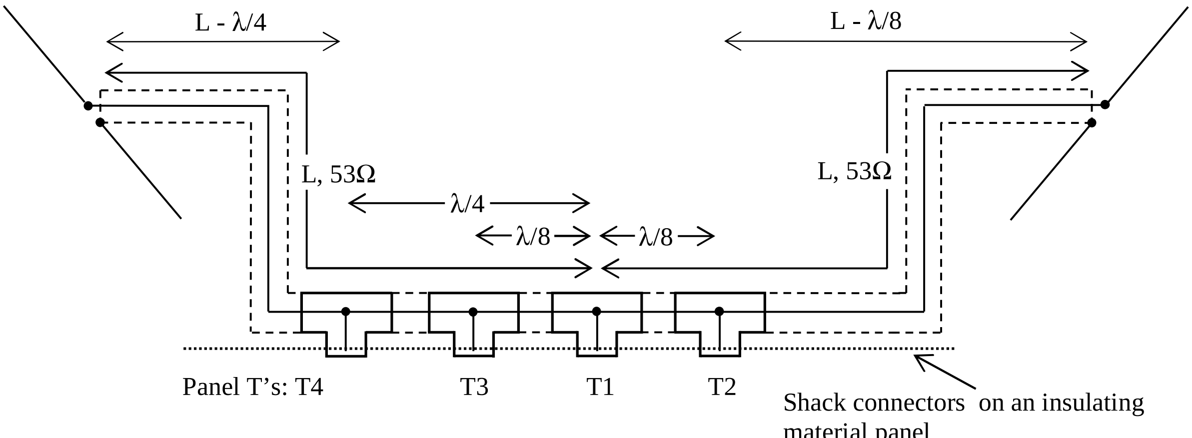

Figure 1

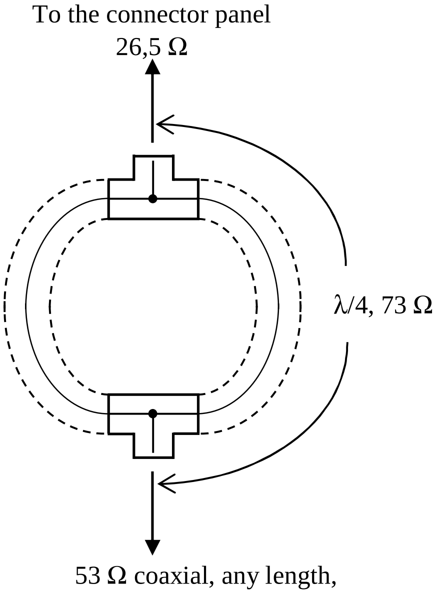

Figure 2

A piece of 53 Ohm coaxial with length **2L** (any) is connected between the two antennæ in such a manner that it comes from one antenna, passes through the shack and returns to the other antenna as in figure 1.

The antennae must be mounted so that they are mutually perpendicular and 45° with the horizontal each (if they are mounted on the same boom making a real cross-yagi, their corresponding elements must form a '**X**' rather than a '**+**' in the space).

In the shack we use a panel made of an insulating material[1] with 4 (four) coaxial T's put on it (T1, T2, T3 and T4). T1 is exactly at the center of the cable, that is, it is equidistant (distance **L**) from both antennæ. As the upper part of both dipoles are connected to the same cable conductor (center conductor in our case of figure 1), the connection of a transmitter to connector T1 will produce currents in phase on both antennae with vertical polarization.

As T4 is $\lambda/4$ away from the center, the currents at the two antennæ will now be 180° out of phase and the polarization will be horizontal when power is applied to this T.

As T2 and T3 are $\lambda/8$ away from the center, the currents at the two antennæ will be 90° out of phase and, as the amplitudes are the same (neglecting coaxial losses), we have circular polarization in either direction.

The impedance is 26.5 Ω for any of the T's because the cable is perfectly matched at both ends.

The problem that arises is how to match a 26.5 Ω point to a 53 Ω coaxial cable to the transceiver.

We see that this will be easily done with a 36.5 Ω $\lambda/4$ line because $36.5^2 \cong 26.5 \times 53$.

It can be easily showed[2] that two line pieces with the same electrical length put in parallel are equivalent to a single piece of line with the same electrical length, but with the characteristic impedance $\mathbf{Z_0}$ following the parallel resistance law, that is, $1/Z_0 = 1/Z_1 + 1/Z_2$, where Z_1 and Z_2 are the impedances of the two line pieces.

So, if we put two pieces of $\lambda/4$ 73 Ω in parallel (to use T's, as in fugure 2, is a good idea), we get just an equivalent piece of $\lambda/4$ 36.5 Ω line.

Thus, by changing the T where the impedance transformer of figure 2 is connected on the panel, we can choose among the 4 possible polarizations **at the shack**, with no relays or remote control.

[1] A conducting panel would short-circuit the cables shields.

[2] See the article "Transmission Lines in Parallel" of the same author .