WAVELENGTH, VELOCITY OF PROPAGATION

Wave propagation is any of the ways in which waves travel. With respect to the direction of the oscillation relative to the propagation direction, we can distinguish between longitudinal wave and transverse waves. For electromagnetic waves, propagation may occur in a vacuum as well as in a material medium. Other wave types cannot propagate through a vacuum and need a transmission medium to exist.

Wavelength

The distance the wave travels along the line while the phase angle is changed through 2Π radians is called wavelength. $\lambda = 2\pi / ß$

The change of 2π in phase angle represents one cycle in time and occurs in a distance of one wavelength, $\lambda = v/f$

VeIocity

$V = f\lambda$

$V = \omega / ß$

This is the velocity of propagation along the line based on the observation of the change in the phase angle along the line. It is measured in miles/second if ß is in radians per meter.

We know that

$Z = R + j\,\omega L$

$Y = G + j\,\omega C$

Then

$$\gamma = \alpha + j\beta = \sqrt{ZY}$$

$$= \sqrt{RG - \omega^2 LC + j\omega(LG + CR)}$$

Squaring on both sides

$$\alpha + 2j\alpha\beta - \beta = RG - \omega\ LC + j\omega(LG + RC)$$

Equating real parts and imaginary parts we get

$$\alpha = \sqrt{\frac{RG - \omega^2 LC + \sqrt{(RG - \omega^2 LC)^2 + \omega^2 (LG + CR)}}{2}}$$

And the equation for ß is

$$\beta = \sqrt{\frac{\omega^2 LC - RG + \sqrt{(RG - \omega^2 LC) + \omega^2 (LG + CR)}}{2}}$$

In a perfect line R=0 and G = 0 , Then the above equation would be

$$\beta = \omega\sqrt{LC}$$

And the velocity of propagation for such an ideal line is given by

$$v = \frac{\omega}{\beta}$$

Thus the above equation showing that the line parameter values fix the velocity of propagation