Meaning of $Z$ for a transmission line

1) $Z = \frac{V}{I}$ for a right-travelling wave on an $\infty$ coax

When we first connect an ohmmeter, it applies a voltage, launching a propagating wave in the cable:

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          V
          ↓
          V = \frac{1}{\delta L C_0} x
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As the wave front moves right, more length of the capacitance of the cable must be charged $\Rightarrow$ we must supply a constant $I$

$\Rightarrow Z = \frac{V}{I}$ is well-defined.

For a finite-length coax, the wave quickly reaches the end, generates a reflection, which then travels back to start generating a new reflection, etc.

Fairly quickly, the system settles to a state with $I = 0$, $V > 0$ along entire length of cable.

2) $Z$ = a resistance that "feels" like an $\infty$ coax cable $\Rightarrow$ it generates no reflections, dissipates all the incident energy

\[ Z = 50 \Omega \]

"terminator"

Snell's law

Any kind of 2D or 3D waves

\[ \frac{V_1}{V_2} = \frac{\sin \theta_1}{\sin \theta_2} \]

for em waves:

\[ n = \frac{c}{V} \]

Snell's Law

For appropriate curvature, all rays pass through a single point.

Focal length: