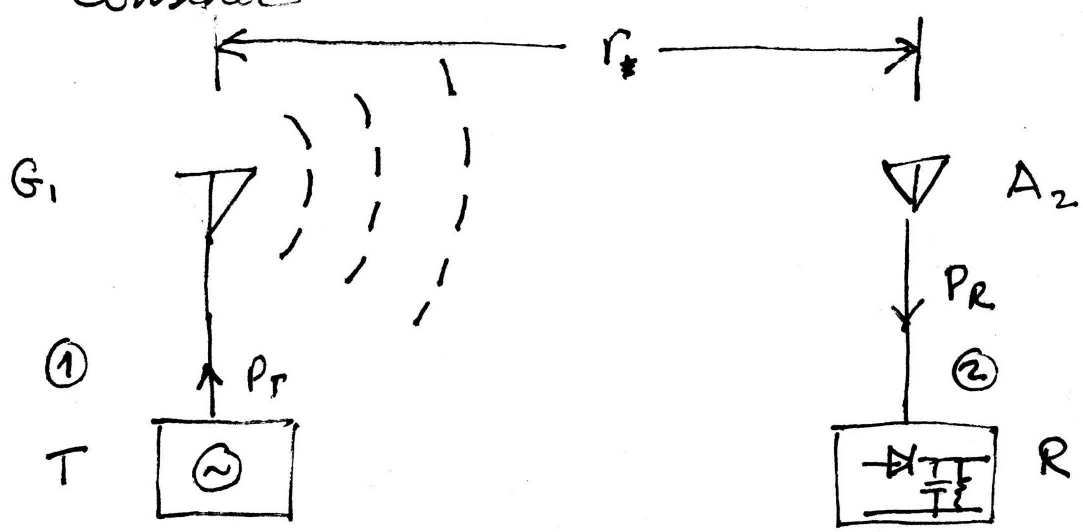
What is the connection between G & A ?

Consider



$$W_1 = \frac{P_T G_1}{4\pi r^2}$$

$$P_{R_2} = \left[\frac{P_T G_1}{4\pi r^2}\right]\left(A_{eff} = A_2\right)$$

$$= W_1 \cdot A_2$$

./...

/...

Swap T, R

$$P_{R_1} = \frac{P_T G_2 A_1}{4\pi r^2} \qquad P_{R_1} = P_{R_2} \text{ by reciprocity}$$

$$\therefore \quad G_1 A_2 = G_2 A_1, \quad \frac{G_1}{A_1} = \frac{G_2}{A_2} = \text{constant!}$$

So effective apertures and gains are in a constant ratio! But antennas were arbitrary!!

$\therefore \quad \frac{G}{A}$ is fixed for any antenna

(where reciprocity holds)

/...

For Ideal Dipole we know the answer,

$$G = 3/2 \qquad A_{eff} = \frac{3}{8\pi}\lambda^2$$

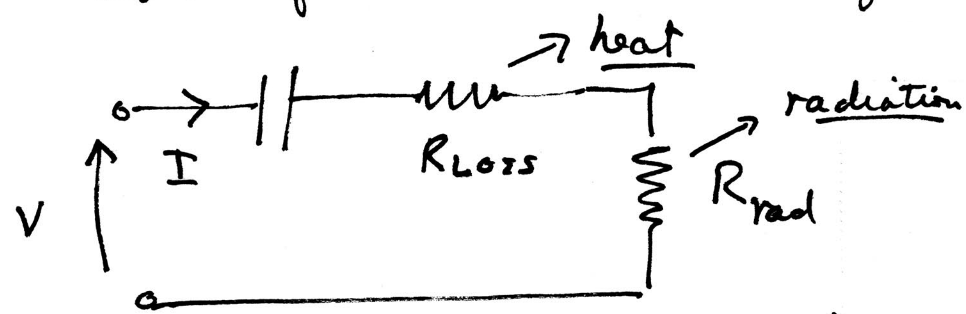
$$\therefore \quad G = \frac{4\pi A_{eff}}{\lambda^2}$$

Using this in expression relating transmitted and received power

$$P_R = P_T \frac{A_T A_R}{r^2 \lambda^2}$$

<u>Friis Transmission Formula</u>

Note that G, A_{eff} are both defined in terms of "space fields" in comparison with input power (G) or extractable power (A_{eff}) at the antenna terminals. This is in contrast with D, which is defined in terms of radiated power. Real antennas have internal loss, so for E. Dipole, e.g., equivalent circuit is really more like



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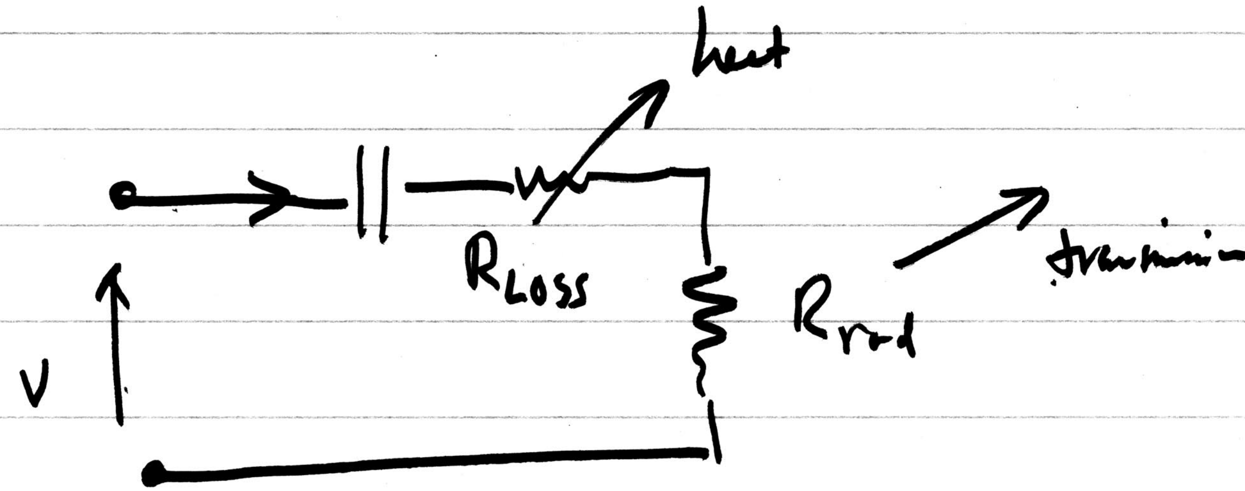
Radiation Efficiency is

$$e = \frac{P_{rad}}{P_{in}} = \frac{R_{rad}|I|^2/2}{(R_{rad}|I|^2 + R_{Loss}|I|^2)/2}$$

$$= \frac{R_{rad}}{R_{RAD} + R_{LOSS}} = \frac{R_{rad} = R_{eff}}{R_{IN}}$$


heat
R LOSS
R rad
transmission
V