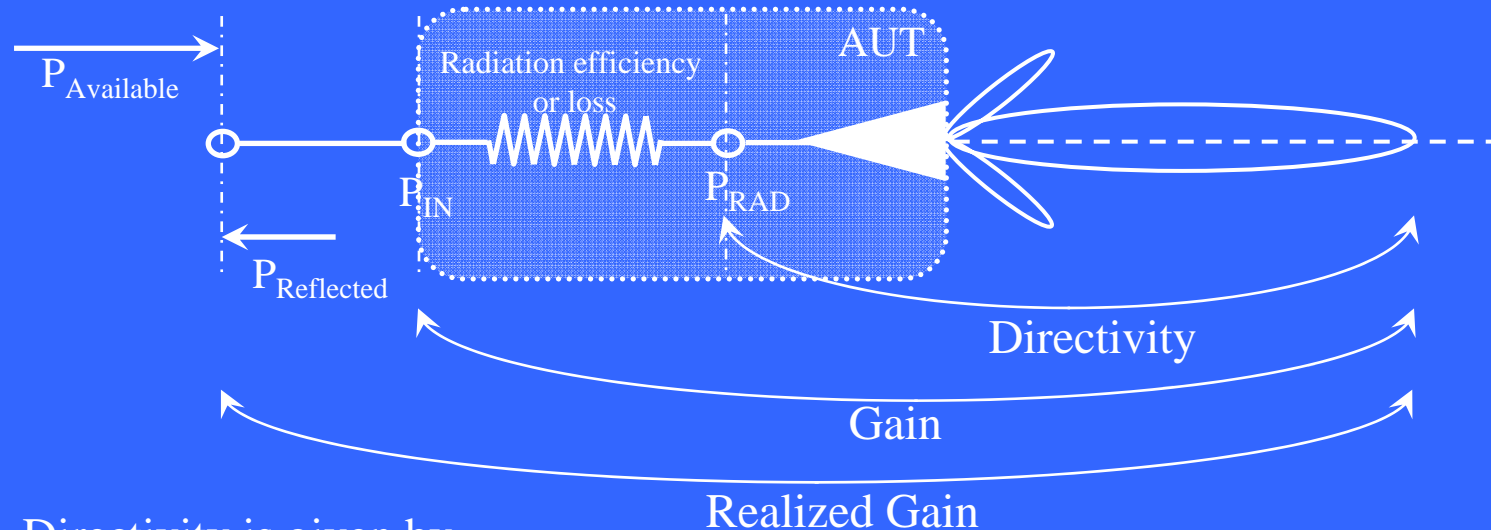# Gain & Directivity

- Directivity is given by,

$$D = 4\pi \frac{\text{power radiated per unit solid angle in direction}}{\text{total power radiated by antenna}}$$

- Gain is given by,

$$G = 4\pi \frac{\text{power radiated per unit solid angle in direction}}{\text{total power accepted from source}}$$

- In practice, many people measure realized gain which *is* affected by VSWR and internal ohmic losses.

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Gain, Directivity & Efficiency

- Gain in a direction is given by,

$$G = 4\pi \frac{\text{power radiated per unit solid angle in direction}}{\text{total power accepted from source}}$$

- Directivity in a direction is given by,

$$D = 4\pi \frac{\text{power radiated per unit solid angle in direction}}{\text{total power radiated by antenna}}$$

- Taking e_r to denote radiation efficiency, when expressed in decibel form, directivity and gain can be related through,

$$G_{dB} = D_{dB} - e_{r\,dB}$$

- According to the IEEE standards, gain does NOT include losses arising from:
  - Impedance mismatches (reflection losses),
  - Polarization mismatches (losses).

- In general gain is measured and directivity is calculated.

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