Total Radiated Power

Consider an antenna that propagates a spherical wave of the form:

$$\boxed{\vec{W}(\theta,\phi,r) = U(\theta,\phi)\,\frac{\hat{r}}{r^2}}$$

Recall $\vec{W}(\theta,\phi,r)$ has units of Watts / m^2, so the <u>total</u> radiated power can be found by integrating over any surface surrounding the antenna:

$$\boxed{P_{rad} = \oiint_S \vec{W}(\theta,\phi,r) \cdot \overline{ds}}$$

Makes sense!

$$\left\{\begin{array}{ccc} \left(\dfrac{\text{Watts}}{m^2}\right) & (m^2) & = \text{Watts} \\ |\vec{W}| & A & = P_{rad} \end{array}\right\}$$

Where $P_{rad} \doteq$ Total Radiated Power

The easiest surface to use in evaluating this integral is a <u>sphere</u>.

i.e.

$$\vec{ds} = r^2 \sin\theta \, d\theta \, d\phi \, \hat{r}$$

where

$$0 < \phi < 2\pi$$

$$0 < \theta < \pi$$

$$\therefore \quad P_{rad} = \iint_S \vec{W}(\theta, \phi, r) \cdot \vec{ds}$$

$$= \int_0^{2\pi} \int_0^{\pi} U(\theta, \phi) \, \frac{\hat{r} \cdot \hat{r}}{r^2} \, r^2 \sin\theta \, d\theta \, d\phi$$

$$P_{rad} = \int_0^{2\pi}\int_0^{\pi} U(\theta,\phi)\ \sin\theta\ d\theta\ d\phi$$

Q: This function $U(\theta,\phi)$ seems to be <u>very</u> important. Just what the heck is it ?!?

A: The $U(\theta,\phi)$ describes the antennas' <u>radiation intensity</u> !!