The Reflector Antenna

A reflector antenna is really a great way to get very high gain (and so very high A_e, narrow beam width).

- We generally begin a reflector antenna with a horn antenna.

Yikes! A horn antenna ?!? We would have to make it huge to get very high gain!

⇒ i.e., it would be very large and heavy!

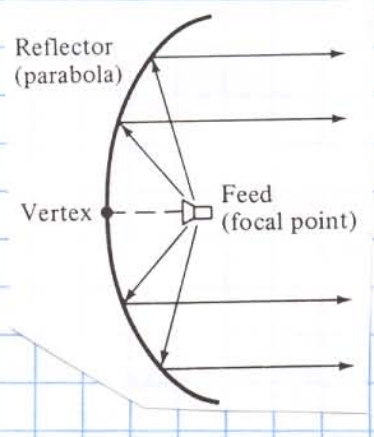
- Relax! Actually, we use a very small horn.

⇒ Huh?! small horn means small gain!

Yes, but we are <u>not</u> finished with our reflector antenna.

- The small horn antenna is called the <u>feed horn</u>. We place this feed horn with a <u>very</u> large reflector. $\Rightarrow$ The <u>reflector</u> size determines the gain!

- For example, the most common reflector is a <u>parabola</u>.



Parabola reflects the feed horn wave into a specific direction!

Figure 13.9 Shaped 10-m earth station dual-reflector antenna (courtesy Andrew Corp.).

- The diameter (d) of the parabola generally specifies its performance (i.e., a 10 m "dish").

- The physical "area" of the parabola is $A_p = \pi\left(\frac{d}{2}\right)^2$

- For an efficient parabola reflector antenna,

$$\boxed{A_{em} \approx A_p = \pi\left(\frac{d}{2}\right)^2}$$

Just like the horn antenna!

- The gain of the antenna is:

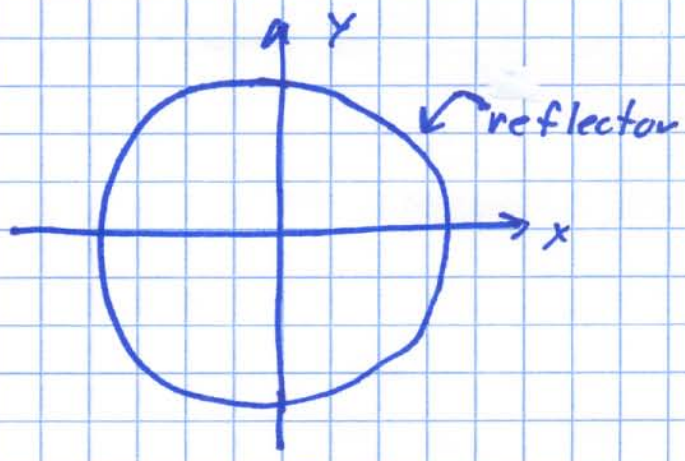
$$\boxed{G_0 = \frac{4\pi}{\lambda^2} A_{em} \approx \frac{4\pi}{\lambda^2} A_p = \frac{4\pi^2}{\lambda^2}\left(\frac{d}{2}\right)^2}$$

- Since gain is large (generally), beam width is small, so:

$$\boxed{G_0 \approx \frac{4\pi}{\Omega_A} \approx \frac{4\pi}{\Theta_x \Theta_y}}$$

But! Since the antenna is circular,

$$\Theta_x = \Theta_y \doteq \Theta$$



$$\therefore G_0 \simeq \frac{4\pi}{\Theta^2}$$

We can equate the two expressions for G_0,

$$G_0 \simeq \frac{4\pi^2}{\lambda^2}\left(\frac{d}{2}\right)^2 \simeq \frac{4\pi}{\Theta^2}$$

i.e. $$\frac{\pi}{\lambda^2}\left(\frac{d}{2}\right)^2 = \frac{1}{\Theta^2}$$

$$\Rightarrow \Theta = \frac{1}{\sqrt{\pi}}\,\frac{2\lambda}{d} = 1.13\,\frac{\lambda}{d} \simeq \frac{\lambda}{d} \quad \text{(radians)}$$

Advantages of Reflectors

- Small volume for large gain.
- Bandwidth same as horn.

Disadvantages

- Design somewhat complex.
- Wind load.
- Works only if $d \gg \lambda$!!