The Reflector Antenna

A reflector antenna is a great way to get very high gain (and so very high $\text{S}/\text{N}$, 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!
$\Rightarrow$ i.e., it would be very large and heavy!

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

$\Rightarrow$ Huh?! Small horn means small gain!
Yes, but we are not finished with our reflector antenna.

- The small horn antenna is called the feed horn. We place this feed horn with a very large reflector. ⇒ The reflector size determines the gain!

- For example, the most common reflector is a parabola.

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,

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

Just like the horn antenna!

- So the gain of the antenna is

\[
\Theta_0 = \frac{4\pi^2 A_{em}}{\lambda^2} = \frac{4\pi^2 A_p}{\lambda^2} = \frac{4\pi^2 \left( \frac{d}{2} \right)^2}{\lambda^2}
\]

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

\[
\Theta_0 = \frac{4\pi}{\lambda \theta} = \frac{4\pi}{\Theta_x \Theta_y}
\]
But! Since the antenna is circular,

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

$$\therefore \Theta_0 \approx \frac{4\pi^2}{\Theta^2}$$

We can also equate

are two expressions for $\Theta_0$,

$$\Theta_0 \approx \frac{4\pi^2}{\Delta^2} \left( \frac{d}{2} \right)^2 \approx \frac{4\pi}{\Theta^2}$$

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

$$\Rightarrow \Theta = \frac{1}{\sqrt{\pi}} \frac{2\lambda}{d} = 1.13 \frac{\lambda}{d} \approx \frac{\lambda}{d}$$ (vandium)

**Advantages of Reflectors**
- Small volume for large gain.
- Bandwidth same as horn.

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