

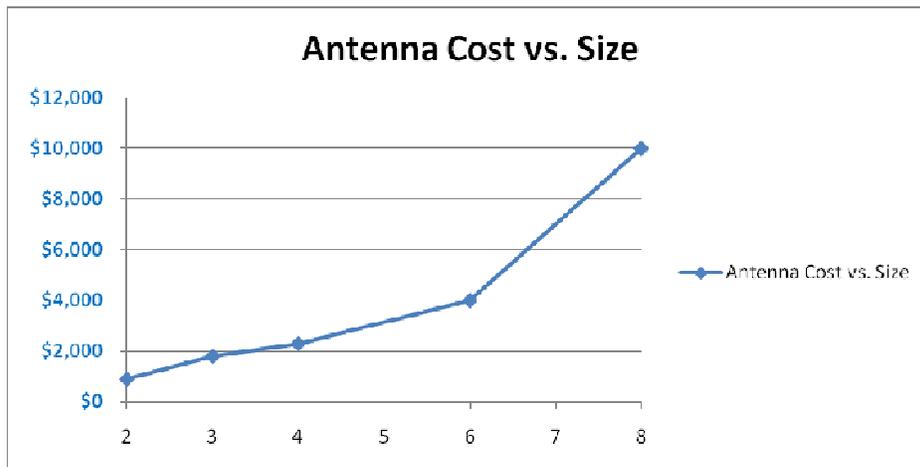
**LINK BUDGET, ANTENNA SIZE and HIDDEN COST OF MICROWAVE LINKS**

In considering a licensed microwave link purchase, minimizing the installation/deployment cost is arguably more important than the radio equipment cost. One critical factor in the installation cost is the antenna size.

When it comes to the antenna size, the bigger is decidedly not better from virtually all considerations. Aside from looking ungainly and aesthetically not pleasing, the use of large antennas will directly and negatively impact your bottom line, both in short-term expenses and long-term recurring operational costs. The following is a quick summary:

- **Antenna costs** – large antennas are often progressively more expensive, but there is a diminishing return on antenna gain as the antenna size gets larger, i.e. the gain enhancement gets smaller for each ft increase in antenna diameter. Some sample costs for different antenna sizes are as follows:

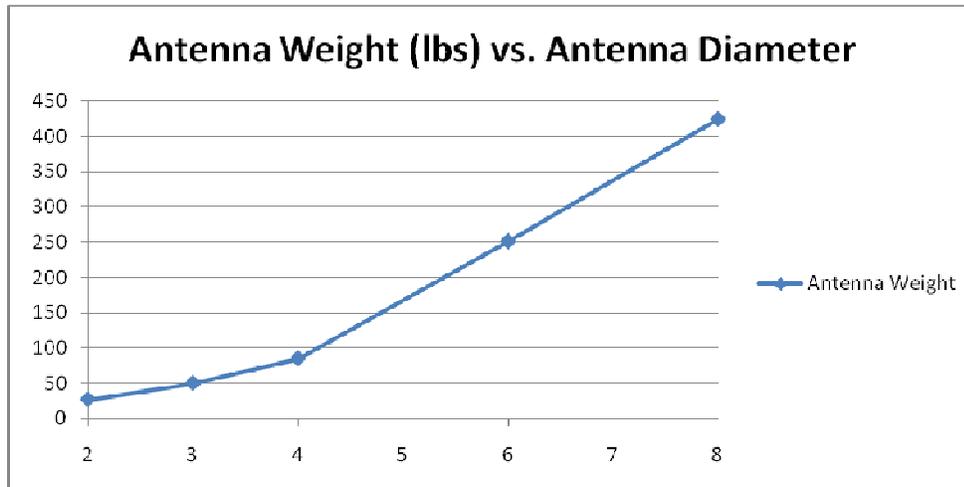
| Size        | 2 ft     | 3 ft     | 4 ft     | 6 ft     | 8 ft     |
|-------------|----------|----------|----------|----------|----------|
| Cost        | \$900    | \$1,800  | \$2,300  | \$4,000  | \$10,000 |
| Gain (7GHz) | 30.7 dBi | 33.9 dBi | 36.9 dBi | 40.3 dBi | 43.0 dBi |



- **Transportation costs** – large antennas are very heavy and ship in wooden crates (3ft or larger), often requiring specially arranged trucking from a freight forwarder.

| Size              | 2 ft | 3 ft | 4 ft | 6 ft | 8 ft |
|-------------------|------|------|------|------|------|
| Net Weight (lbs)  | 27   | 50   | 85   | 251  | 424  |
| Ship Weight (lbs) | 48   | 150  | 200  | 405  | 1150 |

## LINK BUDGET, ANTENNA SIZE and HIDDEN COST OF MICROWAVE LINKS



- **Hoisting equipment Rentals** – large antennas, due to volume and weight, require hoisting equipment like cranes. Rental and operation (labor) of such equipment can be quite expensive and more so if extensive use of such services is needed.
- **Higher Wind-loading factor** – the larger surface area associated with larger antennas (proportional to the square of the antenna diameter) means higher wind-loading factor, which means that towers need to be sturdier. There may be an additional cost for tower engineering.

Note that the windloading factor is proportional to the surface area, e.g. the wind loading factor increases 2.25 times going from 2 ft to 3 ft antenna and increase of 4 times from 2 ft to 4 ft antenna.

- **Tower / Rooftop Space Rental** - Large antennas require more space on the tower and thus the user will be charged higher tower rental costs. Most users are especially sensitive to an increase in a recurring cost like this.
- **Difficulty in Building Approval** – Poor aesthetics with larger antennas means that rooftop approval from the building owner may be more difficult to obtain. Some places may have ordinances against large, protruding antennas.

For all of the above reasons, it is advantageous to keep the antenna size at the minimum, so long as you can maintain the desired link availability. Then, the issue is to pick a radio system with best link budget to allow deployment of small antennas in most applications

The Solectek CM Series is designed to provide industry leading link budgets for customers interested in reducing the antenna size. The improvement in transmitter power and receive sensitivity over competing systems is often 6 dB in total, equivalent to 3 dBi antenna gain on each side.

The improvement in link budget is most pronounced at 256QAM which has been impractical to use due to low Tx and Rx figures. The Solectek CM Series offers the possibility of 256QAM operation with small size antennas for short-haul applications.

## LINK BUDGET, ANTENNA SIZE and HIDDEN COST OF MICROWAVE LINKS

An example of the effect of Tx/Rx figure is shown in the following examples.  
The test case has the following conditions:

- Frequency band: 11 GHz
- Link Distance: 10 km
- Channel BW: 40 MHz
- Link Availability: 99.999% required.
- Rain Region: K, Eastern US
- Sites have clear LOS with the first three Fresnel zones clearance.

The following are the link availability figures calculated with PATHLOSS, a commonly used microwave link profile analysis program:

- Solectek CM Series with 3ft antenna: 99.9994%
- Dragonwave Horizon Compact with 3ft antenna: 99.998%
- Dragonwave Horizon Compact with 4ft antenna: 99.9992%

Thus, in order to satisfy the “five-nine” availability, Dragonwave Horizon Compact link will require the use of 4 ft antennas. Solectek CM can use 3 ft antennas to achieve the same availability.

This means savings, both short and long terms, coming from smaller antennas and as mentioned above, such savings could run thousands of dollars per link and could be the determining factor in evaluating the total cost of ownership of a licensed microwave link.

Ask your Solectek representative how the Skyway CM Series can improve your bottom line today!