



More Than Just a Piece of Wire . . .

By Roger Owens, Chief RF Engineer, Skywave Antennas, Inc.

The antenna is the key to maximizing RF coverage. By selecting the right antenna, you may be able to shorten the application design cycle while achieving maximum performance at the best possible cost. In most designs you need to carefully consider range, coverage of signals, gain, radiation patterns and efficiency. Each one of these areas can be manipulated through an effective use of the correct antenna. We believe that you can have the best electronics in the world, but in any RF application the antenna is very important.

...wireless makes sense!

Wireless networks serve many purposes including improving passenger safety, security, productivity and increasing operating efficiencies. With budget cuts and revenue shortfalls, it is critical to look for product improvement and cost savings. Utilizing wireless technologies in the transportation market is becoming more prevalent to reducing operating costs and set up time. Some companies have saved millions in cost by not having to work with traditional copper and fiber. There are different tools for assessing your network needs and choosing the correct antenna is vital.

...options and more options

Although any metallic object will radiate, this does not make it an efficient antenna. There are many different antenna configurations: Omni Directional, Directional Arrays, Yagi, Loops, Dipoles, Circular, Polarized, Patch, base loaded Whips, and collinear types just to name a few. Each antenna design has pros and cons when it comes to their

operation. For example, multiband antennas are convenient, but there most likely will be some tradeoffs in efficiency and performance. Each application will be unique presenting its own challenges.

...location – location -- location

The location of the antenna should be considered when selecting an antenna. The overriding application factors are: will the antenna be used indoors or outdoors; and will the antenna be exposed to any chemicals that require identification. Mounting location has more affect on the ultimate gain and radiated pattern than the antenna type does. Most terrestrial communication systems do not operate in a free space environment, but rather must account for the effect of the earth's surface on the propagation path. There are two key effects: ground loss and path blockage. In environments where metal objects and the ground come into close contact with the antenna, it will cause reflections, absorption, and detuning of any antenna. Think of the analogy of a flash light beam, when it is open and free of obstructions, the light beam will shine a great distance. When placed in or on the ground it will severely limit the distance the beam will cover. On the other hand, if you place the flash light inside of an enclosure, the beam of light will be contained by the enclosure with the exception of any light escaping through the cracks. Although, RF signals will pass through most plastic enclosures... it will effect your signal strength. An antenna should never be located inside a conductive or metal enclosure. When the antenna is mounted at ground level

you cannot compare Base Station to mobile or radiation pattern performance which most antenna books describe. This is due to ground loss eliminating most of the low angle antenna radiation. There will be a dramatic improvement of coverage if you raise the antenna over nearby obstructions.

You will save time and money if your antenna can be tailored specifically to your application.

The RF transmission or reception of a signal can be enhanced by the antenna that is designed and built for a specific application. The enclosure that the antenna is mounted on or enclosed in will probably cause a shift in the required operating range. As a result, antennas purchased from a catalog might not meet the needs required for the application. **You will save time and money if your antenna can be tailored specifically to your application.** It is not as much the mystery of antenna design and performance, as it is experience of what does and doesn't work. The simple fact is the application and mounting location has more affect on the ultimate gain and radiated pattern.

...everybody wants Gain

You'll see all sorts of wild claims for antenna gain that seem incredible, yet highly attractive. Antenna gain is a measure of directivity of the antennas radiated signal. Antennas are a passive devise and will NEVER put out more total power than is put into it. An antenna with Gain focuses power in a particular direction at the cost of reduced power in other directions. Always follow the

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old saying, "If it sounds too good to be true, it probably is." Make sure the Gain advertised is not exaggerated. There are rules that apply to all antenna systems and like all data it can be manipulated. Note: Typically when you double the height, you'll increase your overall gain by 3db.

VSWR is important!

VSWR (Voltage Standing Wave Ratio) is a measure of how efficiently radio-frequency power is transmitted from a power source, through a transmission line, into a load (for example, from a power amplifier - through a transmission line - to an antenna). In an ideal system, 100% of the energy is transmitted. This requires an exact match between the source impedance, the impedance of the transmission line and all its connectors, and the load's imped-

ance. In real systems, mismatched impedances cause some of the power to be reflected back toward the source (like an echo). Reflection causes power loss in your antenna system and if high enough cause damage to the transmitter or cause it to shut down. This may cause a loss of the data line leading to increased maintenance cost.

As the match of a system improves, return loss increases and VSWR decreases. A well-matched antenna system should exhibit a return loss of >20dB (VSWR 1:1.22).

By choosing the correct antenna options, the correct location, taking in consideration the gain and the importance of VSWR, your system will be efficient and reliable, reducing the chance of RF link failure.

Company Description

Skywave antenna's products are "more than just a piece of wire™." We design antennas to meet your specific application. In most cases we offer a lower price than an off the shelf antenna. We provide free engineering and free samples for qualified opportunities. What really sets us apart is our ability to meet your needs. Every design has it's challenges and we want to be with you every step of the way.

About the Author

Roger Owens has over 40 years experience in engineering design, testing and manufacturing. He has published numerous design articles and has multiple joint patents with Skywave Antennas, Inc. His past work experience includes Fluke, Motorola, and GTE. He is currently employed as the Chief RF Engineer responsible for the design, manufacturing and R&D with Skywave Antennas, Inc. His many years of engineering experience provide Skywave with invaluable RF solutions for our customers' unique applications.



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