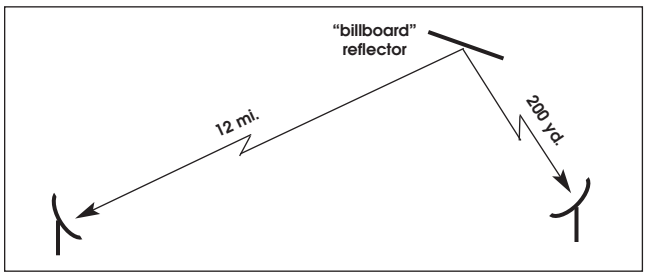
ASK THE EXPERTS

From December 2005 *High Frequency Electronics*

Microwave Reflectors and Diversity

Editor:

I am having trouble getting an answer about passive repeaters. Are billboard reflectors better used in the near field as opposed to the middle field as opposed to back-to-back dishes? We have a path that is experiencing fades because it has been setup as a space diversity path, but the billboard is less than five hundred yards from one end. I cannot convince any one it is because when a fade happens that the beam is missing the billboard and the space diversity at the end of the short leg is useless. See figure below.



The site at the end of the long leg switches to the B receiver in a fade condition, that end never fails. The site on the short leg during a fade condition experiences eye closure on both receivers simultaneously. Any help is appreciated.

Paul H. Dolton,
Southern California Edison

Short and Long Legs are Separate Paths

Paul:

This system has two distinct paths; between each end and the reflector. Your understanding is correct—space diversity on the shorter path has little value, since a 200-yard path will not see the propagation effects that require diversity. For diversity to work at the end near the reflector, it must be implemented at the reflector. A second reflector (or passive repeater) would be required. That reflector would be located at the same offset that has been calculated for the diversity antenna, which may not be practical for a typical "high/low" diversity antenna setup where the antennas may be separated by 100+ feet in height.

Regarding your question about passive repeaters (back-to-back dishes) versus a billboard reflector, the main issues are the physical constraints of the reflector location. The projected area of a reflector is proportional to the sine of the angle between the ray and the surface of the reflector. A path that has a very shallow angle will have only a small amount of energy illuminating the reflector. Use a billboard only when there is a significant angle between the two path segments.

On the other hand, back-to-back dishes have no limitations on the angle between the arrival and departure directions. They also do not require line-of-sight paths in both directions—each dish only needs to see its target site. However, the dishes should be close enough to one another to minimize feedline losses. This type of passive repeater can be used to "see" around corners or other obstacles. Another advantage to this type of repeater is its flexibility in selecting the antenna gains to control the total path loss.

Both types of direction-changing introduce significant additional loss beyond a single path of the same length. In the case of the flat reflector, its size is small relative to the Fresnel zone ("spread") of the signal, and only a portion of the wavefront is reflected. Back-to-back dishes add losses because they create two totally independent paths. The sum of the losses of any two microwave paths is greater than the loss of a single path that is the same total length.

Both types of systems are designed for use in the far field. Readers should note that the type of passive reflector described by Mr. Dolton is not the same as a "periscope" antenna—a ground-mounted dish with a reflector mounted above it on the tower. In the periscope system, which is a near-field system, the reflector is close enough to the dish that it captures nearly all of the incident energy and reflects it to the desired path. The value of this configuration is two-fold—it minimizes feedline losses between the radio equipment and the antenna, and the sidelobes of the main antenna do not see the noise from the warm ground, only from cold outer space and the relatively benign (at microwave frequencies) atmosphere.

Starting in January—*Design Notes*

This column will be re-named "Design Notes" starting with the January 2006 issue. We will continue to answer reader questions, but this page will also be used to present short, practical notes on circuit design, test setups and other handy engineering information.

Readers are encouraged to submit their ideas for inclusion on this page—every engineer I've met has an arsenal of clever little ideas, and I know they enjoy seeing the ideas that their fellow engineers have come up with. Send *your* idea to Gary Breed, Editorial Director at: gary@highfrequencyelectronics.com