TIL-TEK

APPLICATION NOTE No. 1

13 dBi OMNI ANTENNAS

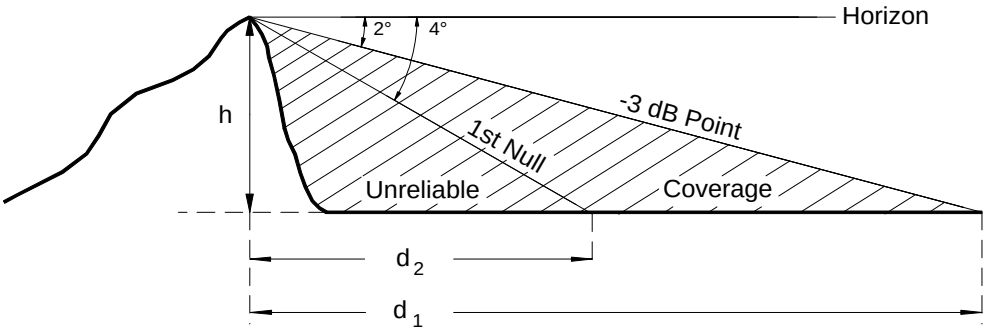
Despite our best efforts to discourage the use of high gain omnidirectional antennas in point-to-multipoint systems, our sales for these types of antennas have increased in recent years, and as expected, so have the complaints from the field, with most of the problems being due to improper installation practices.

Rural radio systems are often 'stretched' to the limit where every dB of antenna gain becomes important. In a point-to-multipoint system, the ideal is to maximize the gain of the central station antenna so that the cost of the outstation antenna systems (antennas, transmission lines, antenna support structures) can be minimized. When considering a 13 dBi omnidirectional antenna at the central station, the following points should be kept in mind:

1. In order to increase the gain of an omnidirectional antenna from 10 dBi to 13 dBi, the half-power elevation beamwidth must be decreased by half. The elevation beamwidth (3 dB points) of a 13 dBi omnidirectional antenna is only 4 degrees (± 2 degrees).

2. The nulls between the main lobe and the first sidelobes in the elevation pattern for a collinear array fall at approximately twice the 3 dB beamwidth i.e. ± 4 degrees for a 13 dBi omnidirectional antenna.

The sketch and table below indicate the coverage that can be expected from a 13 dBi omnidirectional antenna.



h = difference in height between the central station and the outstation antenna.

d_1 = approximate distance (radius) from the central station to the point where the half-power beam hits the ground.

d_2 = approximate distance (radius) from the central station to the point along the ground that would be the first null.

h (m)	d_1 (km)	d_2 (km)
100	2.9	1.4
200	5.7	2.9
400	11.4	5.7
800	22.9	11.4

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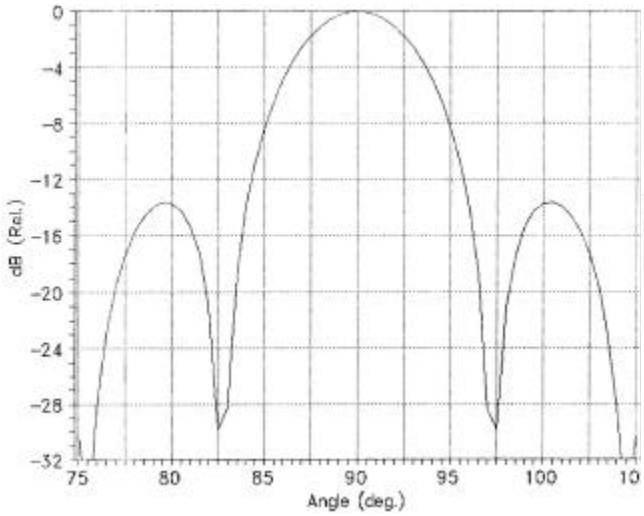
If the gain of an omnidirectional antenna is increased from 10 dBi to 13 dBi (number of dipoles doubled), the sidelobes in the elevation pattern become very narrow making their measurement (direction and roll-off) a challenge on even the best antenna ranges. As a result, most antenna manufacturers publish 'typical' radiation patterns which ignore sidelobe level changes with frequency and range measurement errors.

Also with a half-power elevation beamwidth of 4 degrees (±2 degrees), a 13 dBi omnidirectional antenna must be mounted on a relatively solid structure and in a truly vertical (plumb) position. Consider the case where the elevation angle for an outstation coincides with the -3 dB point on the elevation pattern. If the wind loading on the antenna support structure results in he antenna tilting downwards a couple of degrees, the received signal level at the outstation will decrease by 30 dB.

Recommendations:

1. Use a 10 dBi omnidirectional antenna and high gain outstation antennas for marginal paths unless this combination is prohibitively expensive.
2. Check the specifications of the antenna support structure (tilt and sway) before deciding to use a 13 dBi omnidirectional antenna.
3. When using a 13 dBi omnidirectional antenna at a mountain top site, make sure that the angle to each outstation is within 3 dB elevation beamwidth specified on the datasheet for the omnidirectional antenna.
4. Consider the use of electrical downtilt to optimize coverage from a mountain top location.

Typical E-Plane 10 dBi Omnidirectional Antenna



Typical E-Plane 13 dBi Omnidirectional Antenna