What is “Gain-Probability”?

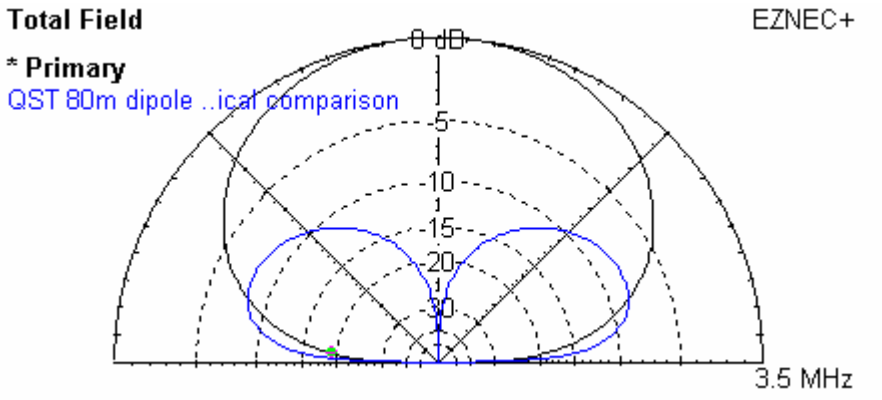
In its simplest form, Gain-Probability combines the calculated far field patterns of an antenna with published propagation data that predicts the incoming angles of signals around the world. Different antennas have different elevation patterns. Different bands have different signal elevations from the same part of the world. Different parts of the world have different incoming signal elevations on the same band. Different QTH’s have different characteristics. Combining these pieces of information gives great insight into antenna performance and is a probabilistic approach to antenna performance (incoming signal angles are given as probabilities).

We will use this combined information to predict the comparative performances of various antennas as to their performance for communications between your QTH and many parts of the world.

To use this approach, you will need EZNEC, an easy-to-use antenna simulation program and the propagation data (*.prn files) bundled with HFTA, a terrain propagation prediction program. Both the EZNEC program and the *.prn files are included with the ARRL’s Antenna Handbook CD. Choose the *.prn file that is appropriate for your QTH and your DX target of interest. There are hundreds of *.prn files included. The ARRL’s version of EZNEC is somewhat limited, but still provides enough horsepower to model most popular antennas. An investment in the full version is well worth the money.

An Example

Let’s use EZNEC to plot comparison patterns between an 80 meter dipole at 30 feet and an elevated vertical with two tuned 80 meter radials. I won’t go into the details of the models because that’s not the point:




This data is available in tabular output form from the EZNEC program. Later, we will take this tabulated data and input it into the G-P spreadsheet to calculate the comparative performance of these two antennas into South Africa and Europe (from the author’s home QTH near Chicago, Illinois.

The Trouble With “Customary” Elevation displays

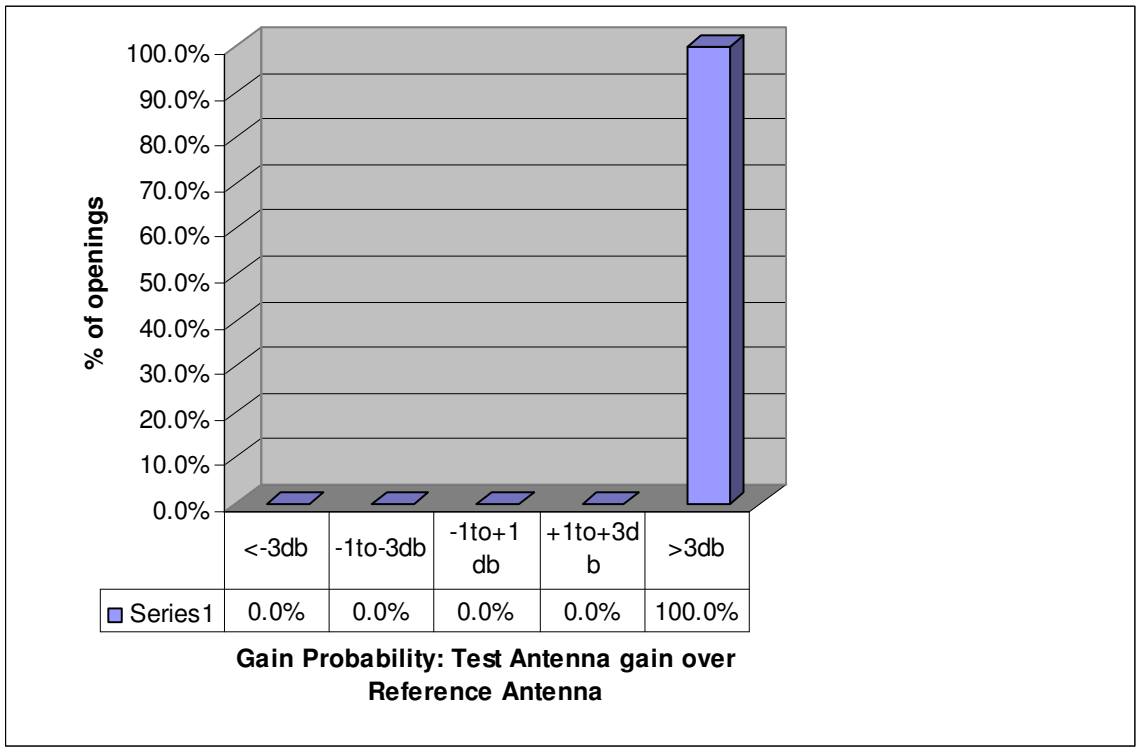
The larger trace above (black) is that of the 80 meter dipole. Without a doubt, it’s much better than the elevated vertical (the smaller, blue trace). Right? It all depends on whom you want to talk to. Let’s take a closer look:

Let’s assume you want to choose which antenna will work better into South Africa from a Chicago, Illinois location. Let’s look at the 80 meter propagation angle probability for the path from Chicago to South Africa:

1 degree: 85.7% of the 80m openings will come in at this angle
2 degree: 14.3% of the 80m openings will come in at this angle
3 degree & up 0%

If you compared the tabular output data from EZNEC rather than just looking at the chart above, you would see that the vertical has 3.89dB of gain over the dipole at 1 degree of elevation. At 2 degrees, the vertical wins by 3.39dB.

The vertical is the clear winner for this path. If you were to plug this into the G-P spreadsheet, it would give the following output:



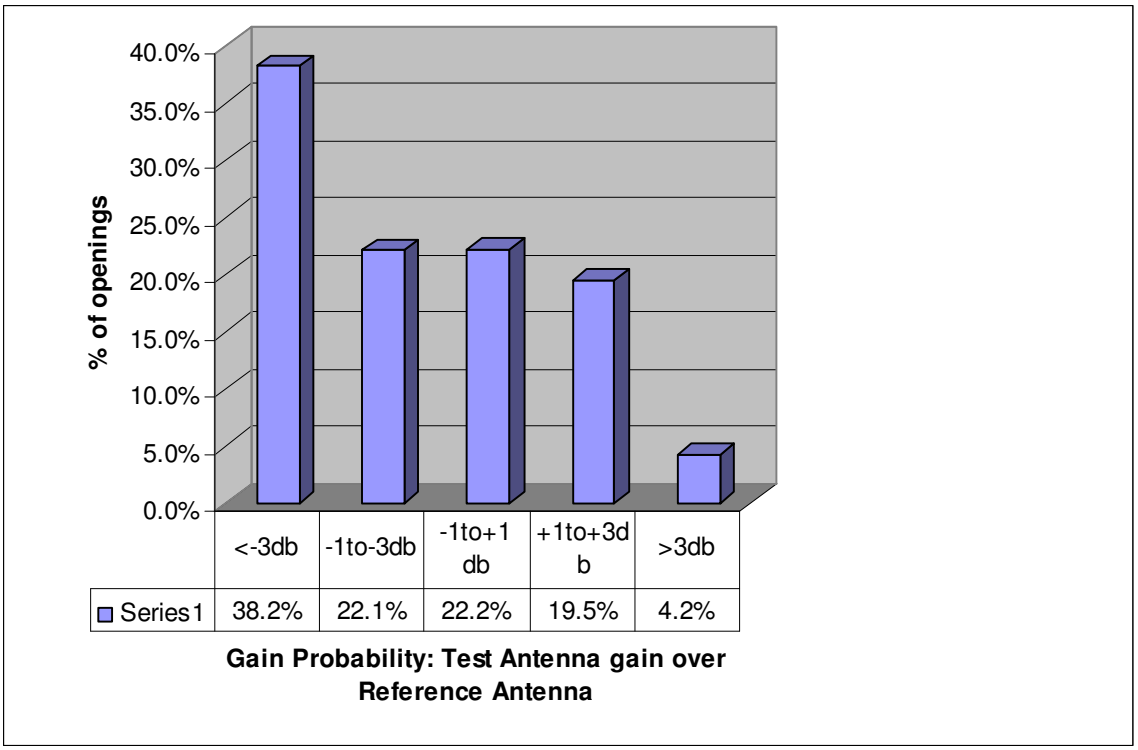
This graphically displays what was said above: during 100% of the band openings between Chicago, Illinois and South Africa, the vertical (test antenna) will outperform the 30 foot high dipole (reference antenna) by more than 3 db.

But what about from Chicago into Europe?

The propagation angle probability data for Europe is shown below:

| Elev | 80m % |
|---|---|
| 1 | 0.1 |
| 2 | 4.1 |
| 3 | 6.1 |
| 4 | 3.7 |
| 5 | 3.9 |
| 6 | 3.7 |
| 7 | 2.1 |
| 8 | 1.4 |
| 9 | 5.1 |
| 10 | 8.3 |
| 11 | 7.4 |
| 12 | 3.7 |
| 13 | 2.3 |
| 14 | 2.9 |
| 15 | 6.7 |
| 16 | 6.5 |

… and so on (the G-P SS loads data up to 60 degrees). Clearly, signals from Europe come in at a higher elevation angle than signals from South Africa on 80 meters. Plugging this data into the G-P spreadsheet gives the following output:




It can be seen that on this path the dipole will beat the vertical by more than 3dB 38.2% of the time and will be 1 to 3 dB better 22.1% of the time. Still, on 45.9% of the openings the vertical will be as good as or better than the dipole into Europe.

So how can you use this information?

A wire dipole in your backyard probably needs to be fixed in its direction. If you wanted to augment your vertical's DX capability by sometimes using a dipole, where should you point it? Pointing it at South America wouldn't do you any good since the vertical always wins on that path. So aim it at Europe where the dipole will win 60.3% of the time. Switch to the antenna with the best signal.

Plug in the EZNEC calculated data for the antennas you would like to compare and then add in the propagation angle probability for your QTH from the ARRL handbook. Which antenna is better into Japan, a dipole or a full wave loop? Simply model it in EZNEC and enter the data into the G-P spreadsheet.