Where's My Site: The Mystery of Magnetic Declination Explained

Resolving magnetic declination is only one aspect of installing and aligning microwave antennas, but it is a critical aspect. Here's how to compensate for the difference between true north and magnetic north

By Andy Singer

Magnetic declination is essential to understand for anyone tasked with aligning microwave antennas. Magnetic declination can have a serious effect on the ease of locating one site from a position at another site or location, yet it is a subject that is not widely understood. Learning what magnetic declination is and how it affects locating positions at a distance helps to simplify antenna alignment and makes alignment steps more efficient.

Most maps are laid out so the point in the northern hemisphere where all longitudinal lines meet is toward the top. The point is called true north, map north or geographic north. Magnetic north, the direction in the northern hemisphere toward which compasses point, is not the same as true north. Earth is like a giant magnet with two poles. A compass aligns itself with Earth's magnetic poles. Magnetic north doesn't hold still. Because of movement in the Earth's molten core, magnetic north is moving toward the north-northwest.

From any given point, the angular difference in direction between true north and magnetic north is called the magnetic declination. Figure 1 shows the lines of recent magnetic declination in the United States. Magnetic declination varies from as much as 20 degrees in parts of Maine to 0 degrees in Illinois to more than 20 degrees in Washington state.

The movement of the magnetic north pole is rapid enough to shift the magnetic declination about 1 degree to the west every year. Thus, it is important to use a recent magnetic declination map for accuracy in compensating for the declination.

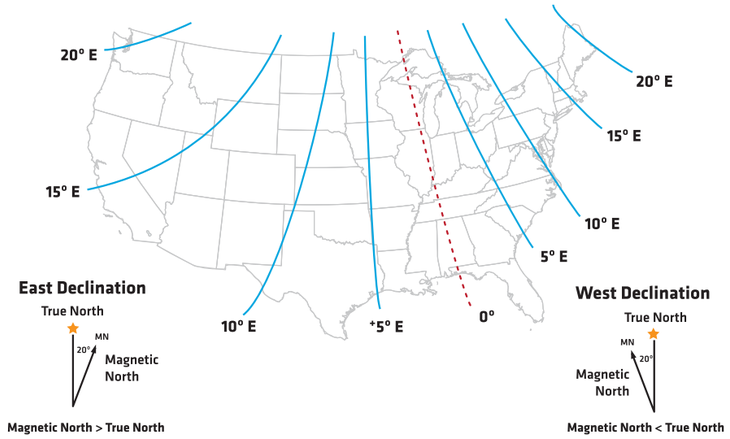

Figure 1. The lines of recent magnetic declination in the United States. Magnetic declination varies from as much as 20 degrees in parts of Maine to 0 degrees in Illinois to more than 20 degrees in Washington state. A technician attempting to align a microwave antenna without taking magnetic declination into account may never find the target site because it will be so far from where it is expected to be.

When bearings are expressed in degrees, north is defined as 0 degrees, and the number of degrees begins rising with bearings that lie to the west of north, moving 360 degrees thorugh east, south, west and back to north at 0 degrees.

The difference between using true north versus magnetic north when aligning antennas can be significant, depending on the amount of magnetic declination for a given location. How much difference can it make? Table 1 shows the calculated potential error in distance versus the magnetic declination. If the magnetic declination is 1 degree, the resulting error in antenna alignment may not be significant. But where magnetic declination is 10 degrees, an antenna aligned with the use of a magnetic compass, without correcting for the declination, could wind up pointing 9,000 feet to the side of an intended target site 10 miles away. The error worsens as the magnetic declination increases. A technician attempting to align a microwave antenna without taking magnetic declination into account may never find the target site because it will be so far from where it is expected to be.

A map bearing, which is used for locating sites on a map, is a horizontal angle measured clockwise from north to some point on the map or in the real world. The compass is the tool most commonly utilized in the field to take a bearing measurement. You can think of true north as 12 o'clock on a clock face and any bearing clockwise, to the right, such as 2

MAGNETIC DECLINATION

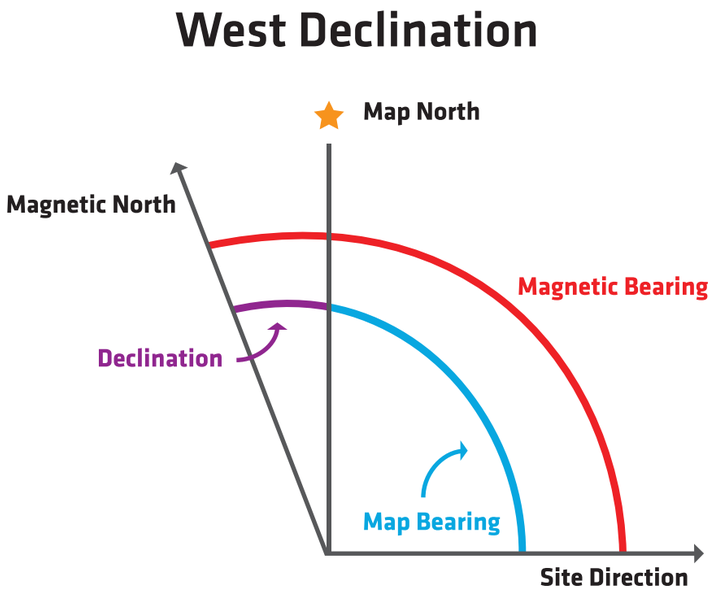

Figure 2. A calculation for a west declination corrects for the compass direction of magnetic north to indicate the desired direction toward a target microwave antenna.

o'clock, is greater than true north. Any bearing to the left of true north, such as 11 o'clock, would be less than true north. Keep in mind that map north is not typically the same direction as magnetic north. Thus, when you take a bearing with a compass, it's a magnetic bearing.

So far, we have determined the difference between true north (map north) and magnetic north and how much of an effect the difference can have on determining a site location. This difference becomes critical when trying to align a pair of microwave antennas at locations miles distant from each other. How do we then calculate this difference and make adjustments for it?

Figure 2 shows the calculations for a west declination adjustment where magnetic north is west of true north. In this case, if you are using your map and taking a map bearing, you would subtract the declination from the compass (magnetic) bearing.

Thus, map bearing — magnetic bearing — declination. Note this is for a west declination. If you are on the West Coast of the United States, the declination is east (your compass points east toward the 0-degree declination line), and the equation would be the opposite such that map bearing = magnetic bearing + declination.

Although magnetic declination is only one aspect of installing and aligning antennas, it is a critical aspect.

Declination or Degree Off	Error Off Target at 10 Miles
1	920 feet
5	4,600 feet
10	9,170 feet

Table 1. The greater the declination or degrees off from true north, the greater the error off target for antenna alignment – in this example, at 10 miles.

About the Author:

Andy Singer, president and CEO of Singer Development, helped develop the remote tilt antenna concept. His company offers a training course. His email is andy.singer @singerexecutivedevelopment.com.