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The Death of ISM?

The Effect of 10.7cm Solar Flux on 2.45GHz Digital Spread Spectrum Communications

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During a current assessment of a large-scale Supervisory Control and Data Acquisition, (SCADA) network, I discovered a potential Y2K issue not associated with conventional computer date problems. It seems the SCADA network in question has a significant quantity of 2.45 GHz Digital Spread Spectrum (DSS) equipment in service. This is low-power equipment typically used for T1 data communications. Because of the radiated power restrictions placed on this service by the Federal Communications Commission, there is often no spare power available in the path budget for use during problem situations.

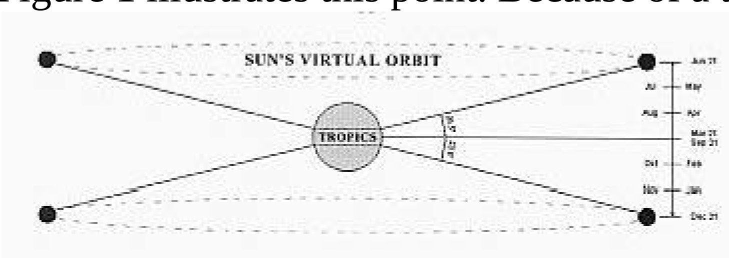
The potential problem becomes apparent when you consider two things; (1) the lack of margin in the path budget and (2) the operating frequency.

First, some "hops" utilize the entire path budget. This is not normally by design. DSS equipment is sometimes used as a direct replacement for higher power equipment at 1.9 GHz removed during the FCC re-farming of frequencies. As a result, towers, mismatched antennas, and old coaxial cable are already in place. Why not use them?

Second, the Sun emits broadband 10.7 cm radiation. This phenomenon was discovered just after World War II. The association between the 10.7 cm emission and sunspots is proven. The appearance of this emission has become a leading indicator of sunspot activity. During the last sunspot maximum (solar activity maximum) eleven years ago, DSS equipment of this type was not in service, as it is now. What will happen when a sunrise or sunset coincides with the azimuth of a high gain antenna? There will be a significant increase in the received noise level. This noise level increase will be exasperated during the solar activity maximum *now showing in our solar system*. If there is not at least 6dB of path budget to spare, there may be a problem. Furthermore, if the system is mission critical to computer communications, there may be a Y2K problem associated with an *external* date!

The sun does not always rise in the east and set in the west. It does twice a year, but the remaining 363.25 days it does not. Forget the Columbus argument for a moment and assume that the Sun revolves around the earth.

Figure 1 illustrates this point. Because of a tilt in the axis of the earth with respect to its orbit, we have seasons. This tilt makes the Sun appear to move north and south of east or west during sunrise and sunset, depending upon the season. Note that the tropic demarcations are 23.5 degrees above and below the equator. Keeping in mind that the Earth and Sun are point sources, and considering the great distances involved, it can be readily seen that an antenna azimuth falling in the range of plus or minus 23.5 degrees from 90 or from 270 degrees will occasionally be aimed at the sun.



A simple plot of sunset and sunrise angles is presented in Figure 2. The plots shown can be used to predict the dates of highest probability for trouble. The period of maximum solar activity is plotted on the X-axis from June of 1999 to June of 2001. Each vertical line represents one calendar month. The Y-axis is the antenna-aiming azimuth from 0 to 360 degrees. Assume there is a hop that is due east-west.

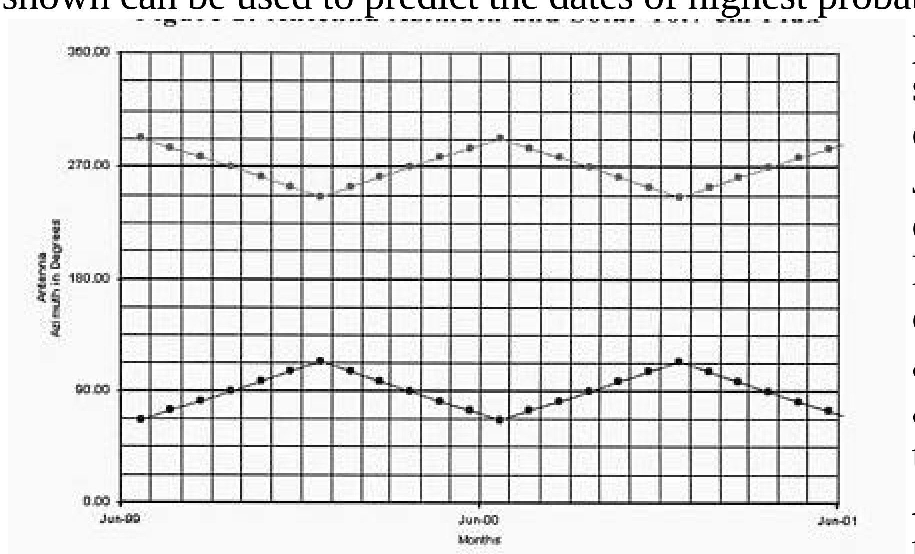


Figure 2: Antenna Azimuth and Solar 10.7 cm Flux

Twice a year, or four times during the solar activity peak, there is a potential problem. In this example, follow a horizontal line corresponding to 90 or 270 degrees, (for east and west). The dates used in Figure 2 are 9/21/99, 3/21/00, 9/21/00, and 3/21/01. These example dates represent the Vernal and the Autumnal Equinoxes. Considering this example, have you had any transient anomalies recently?
Don't assume these "days" will present the only timeframe for problems. Anticipate problems in the weeks leading up to, and away from, suspect dates.

In summary, be prudent. This article is simply a "heads-up" to a potential problem. Look over your systems and determine if and where you might have a problem. Check the path budget to determine the potential severity of the problem and do some "fixing up" if necessary. If you have no budget margin and you have eked all you can from your system, be prepared for some down-time. I hope it all goes well.

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