What is Sun Outage?

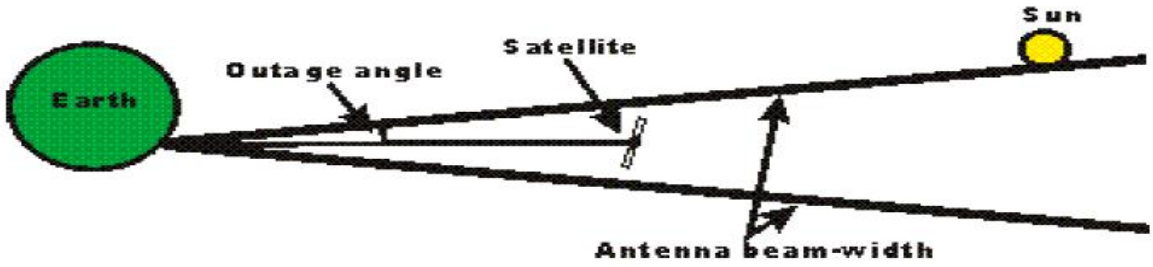
One problem that can occur with satellite systems is what is termed a "Satellite Solar Outage" or "Sun Outage".
During a solar outage it may not be possible to receive the signal from the satellite, or alternatively the signal will be degraded.

Solar outages affect all satellite systems, and they are quite predictable and they arise from the basic physics behind the operation of a satellite system, and indeed any radio communications link.

Satellite solar outage basics

Satellite solar outages occur because the Sun (which is a powerful broadband microwave noise source) passes directly behind the satellite (when viewed from Earth) and the receiver with the beam directed towards the satellite picks up both the satellite signal and the noise from the Sun.

The degree of interference caused by a satellite solar outage varies from slight signal degradation to complete loss of signal as the downlink is swamped by the noise from the Sun.



Mechanics behind a solar outage

For geostationary satellites, the solar outage can typically cause disruption to the received signal for a few minutes each day for a few days. The exact date, time and duration of such events depends on a variety of factors including:

- Receiver location
- Location of the particular satellite
- Size, or more specifically the beam width of the antenna
- The apparent radius of the Sun as seen from the earth (about 0.25).
- Accuracy of alignment of the antenna direction towards the satellite

Parameters such as the antenna directivity can make large differences to the amount of time of the solar outage.

Antennas with a very wide beam width could be affected for as much as half an hour, whereas antennas with higher gain and directivity levels as are more commonly used for satellite reception will be affected for much shorter periods of time. Typically only a few minutes.

The effect of the solar noise causing the outage is very marked. Even at times of low solar activity, the effect is very noticeable and can result in noise levels of between 10 and 20 dB above the signals from transponders, dependent upon a host of factors.

It is possible to define what is termed and outage angle of the receiving antenna. The solar outage angle of the antenna angle is defined as the separation angle (measured from the ground station antenna) between the satellite and the Sun at the time when sun outage or signal degradation begins or ends.

It is not always possible to exactly predict the duration of a solar outage. The exact point at which the solar outage begins and ends is a gradual transition. In addition to this there are many differences between different installations and systems. Accordingly some stations may experience a complete loss of signal while others may only experience a tolerable degradation of signal. In view of this it is not possible to exactly determine the exact solar outage angles without complete information about the ground station equipment and the satellite parameters. However an

$$\text{Outage angle} = (\text{Frequency})^{11} \times (\text{Diameter}) + 0.25^{\square}$$

Where (Frequency) = Downlink Frequency in GHz
Where (Diameter) = Receiver parabolic reflector or dish antenna diameter in meters

When do satellite solar outages occur?

For geostationary satellites, solar outages occur around the equinoxes, i.e. March / April and then again in September / October. At these times of year the Sun crosses the equator and it traces an arc that places it directly behind geostationary satellites.

It is found that the in the Northern Hemisphere, solar outages usually occur in early March and October as a result of the geometry and relative positions of satellites and the solar transit of the Sun. In the Southern Hemisphere, outages normally occur in early September and April. The time of day varies mainly with the longitude of the satellite and receiving station, while the exact days vary mainly with the station's latitude. Stations along the equator will experience solar transit right at the equinoxes, because the satellites in geostationary orbit are located directly over them.

The exact dates and times of the solar outages are easy to predict and many calculators are available. All that is needed is a knowledge of the satellite position (sometimes just the satellite is needed as its coordinates may be held within the calculator), the position of the receiver in

latitude and longitude. The beam width of the antenna is often needed as it will enable the time of the satellite solar outage to be determined.

Summary

While satellite solar outages, or satellite sun outages can be annoying, they are normally short lived and they are totally predictable. They affect all satellites, and in particular these solar outages are commonly experienced as a result of the widespread use of satellite direct broadcast TV reception. However all satellites are affected, whether geostationary or in other orbits, and the effects can cause short lived disruption to the radio communications.