Eclipse

It occurs when Earth's equatorial plane coincides with the plane the Earth's orbit around the sun. Near the time of spring and autumnal equinoxes, when the sun is crossing the equator, the satellite passes into sun's shadow. This happens for some duration of time every day. These eclipses begin 23 days before the equinox and end 23 days after the equinox. They last for almost 10 minutes at the beginning and end of equinox and increase for a maximum period of 72 minutes at a full eclipse.

The solar cells of the satellite become non-functional during the eclipse period and the satellite is made to operate with the help of power supplied from the batteries. A satellite will have the eclipse duration symmetric around the time t=Satellite Longitude/15 + 12 hours. A satellite at Greenwich longitude 0 will have the eclipse duration symmetric around 0/15 UTC +12hours = 00:00 UTC.

The eclipse will happen at night but for satellites in the east it will happen late evening local time. For satellites in the west eclipse will happen in the early morning hour's local time. An earth caused eclipse will normally not happen during peak viewing hours if the satellite is located near the longitude of the coverage area. Modern satellites are well equipped with batteries for operation during eclipse.
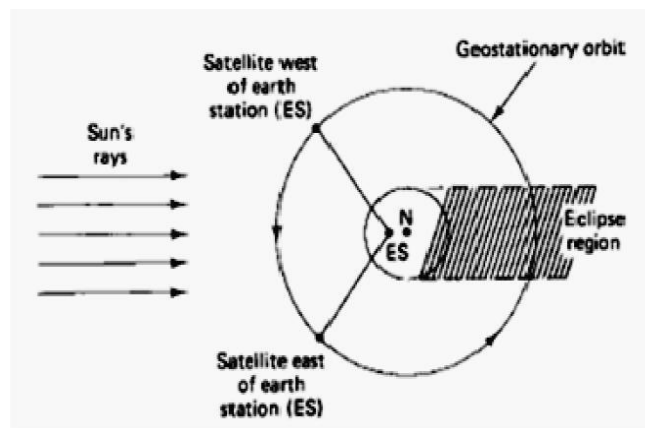

Fig 1.11 A satellite east of the earth station enters eclipse during

daylight busy hours at the earth station. A Satellite west of earth station enters eclipse during night hours

Sub satellite Point

Sub satellite Point is the point at which a line between the satellite and the center of the Earth intersects the Earth's surface. The location of the point is expressed in terms of latitude and longitude. If one is in the US it is common to use -

- Latitude – degrees north from equator
- Longitude – degrees west of the Greenwich meridianas:

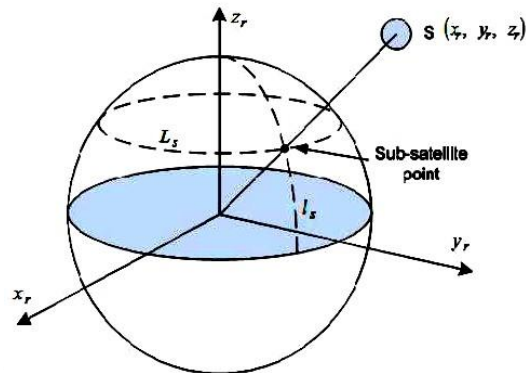$$L_s = \frac{\pi}{2} - \cos^{-1}\left(\frac{z_r}{\sqrt{x_r^2 + y_r^2 + z_r^2}}\right)$$

Fig 1.12 Sub satellite Point

Sun Transit Outage

Sun transit outage is an interruption or distortion of geostationary satellite signals caused by interference from solar radiations. Sun appears to be an extremely noisy source which completely blanks out the signal from satellite. This effect lasts for 6 days around the equinoxes. They occur for a maximum period of 10 minutes.

Generally, sun outages occur in February, March, September and October, that is, around the time of the equinoxes. At these times, the apparent path of the sun across the sky takes it directly behind the line of sight between an earth station and a satellite.

As the sun radiates strongly at the microwave frequencies used to communicate with satellites (C-band, Ka band and Ku band) the sun swamps the signal from the satellite. The effects of a sun outage can include partial degradation, that is, an increase in the error rate, or total destruction of the signal.
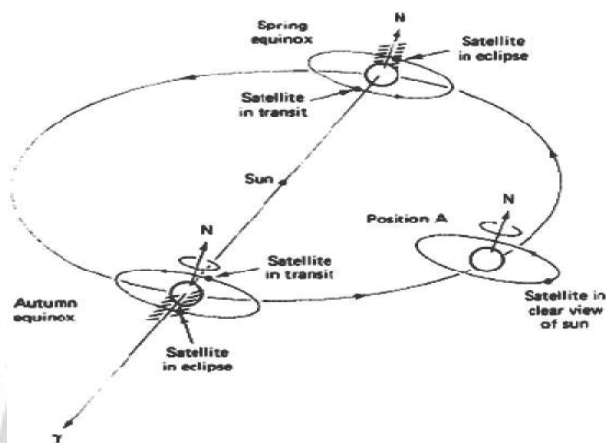

Fig 1.13 Earth Eclipse of a Satellite and Sun transit Outage