Ground Coverage

The Figure 1 shows the ground coverage geometry of a spacecraft. The satellite is at altitude h and the 'viewing angle' is 2α. This may be approximated as the field of view of the beam width of the communication antenna. It defines the circle of coverage on the ground of geocentric semi-angle ϕ and diameter D km. The diameter D is the arc GG'. The satellite elevation and the slant range at the edge of the coverage are respectively ε and ρ.

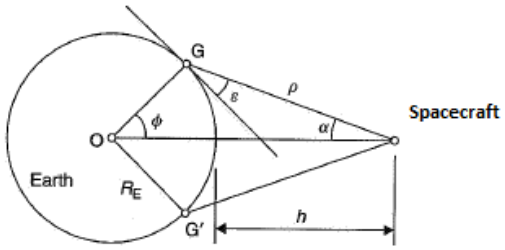

Figure 1: Ground coverage geometry

Since,

$$\varepsilon = \frac{\pi}{2} - \phi - \alpha$$

We have

$$\phi = -\varepsilon + cos^{-1}(\frac{R_E}{R_E + h}\cos\varepsilon)$$

And the coverage diameter is equal to

$$D = 2\phi R_E$$

Concerning the chord |GG'|, the formula is

$$l = 2R_E \sin\phi$$

In this example, apogee of the satellite is at 650km and it is considered as the worst case. The earth radius is 6371km. Giving Earth radius and altitude, the table below provides the different coverage radiuses against different elevations and additionally the chord |GG'|.