

Downloading data

CryoSat II is operated (TT&C) from the ESA/ESOC center in Darmstadt in Germany, but it is at the earth station in Kiruna that the earth observation data is downloaded. The TT&C carrier frequency is in S-band, while the download is performed on an X-band down link with a center frequency of 8.1GHz, and has a download transfer rate of 100Mbit/s.

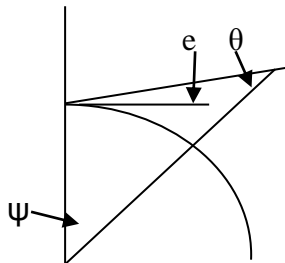
The height of the orbit is 725 km above the surface of the earth, and the earth radius is 6370 km.

If we consider a satellite pass with the satellite passing right over the gateway in Kiruna, and the download cannot start before the satellite is 10 degrees above the horizon on its way up, and similarly stops when the satellite is on its way down with an elevation angle of 10 degrees, for how long time will the earth station see the satellite at this pass, and how much data can be downloaded?

Answer:

Find the orbital period with Kepler's third law: $T=5947s$

Use «law of sines»:



$$\sin(e+90^\circ)/(R_e+h) = \sin(\theta)/R_e \Rightarrow \sin(\theta) = 6370 \cdot \sin(100)/(6370+725) = 0.8842$$

$\theta = 62.15^\circ \Rightarrow \psi = 180 - 100 - 62.15 = 18.4^\circ$, in total $2 \cdot \psi = 36.8^\circ$, so the time the satellite is visible is $T_v = 5947s \cdot 36.8/360 = 594.7s$, and the amount of data that can be downloaded is then $100Mb/s \cdot 594.7s = 59.47Gb$.