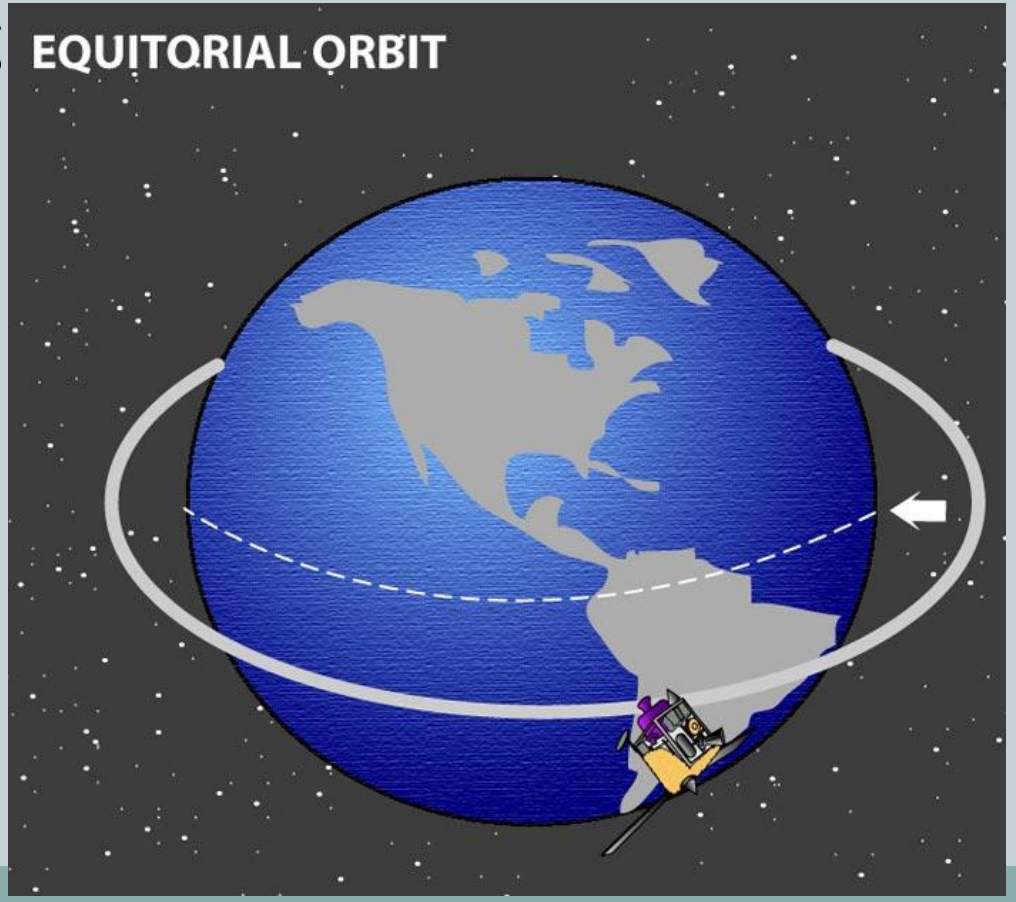
Lecture 25

PRINCIPLES OF SATELLITE COMMUNICATION

ORBIT

- The satellite revolve around the earth in specified orbit.
- The two forces acting earth are
  - Force of momentum
  - Force of gravity



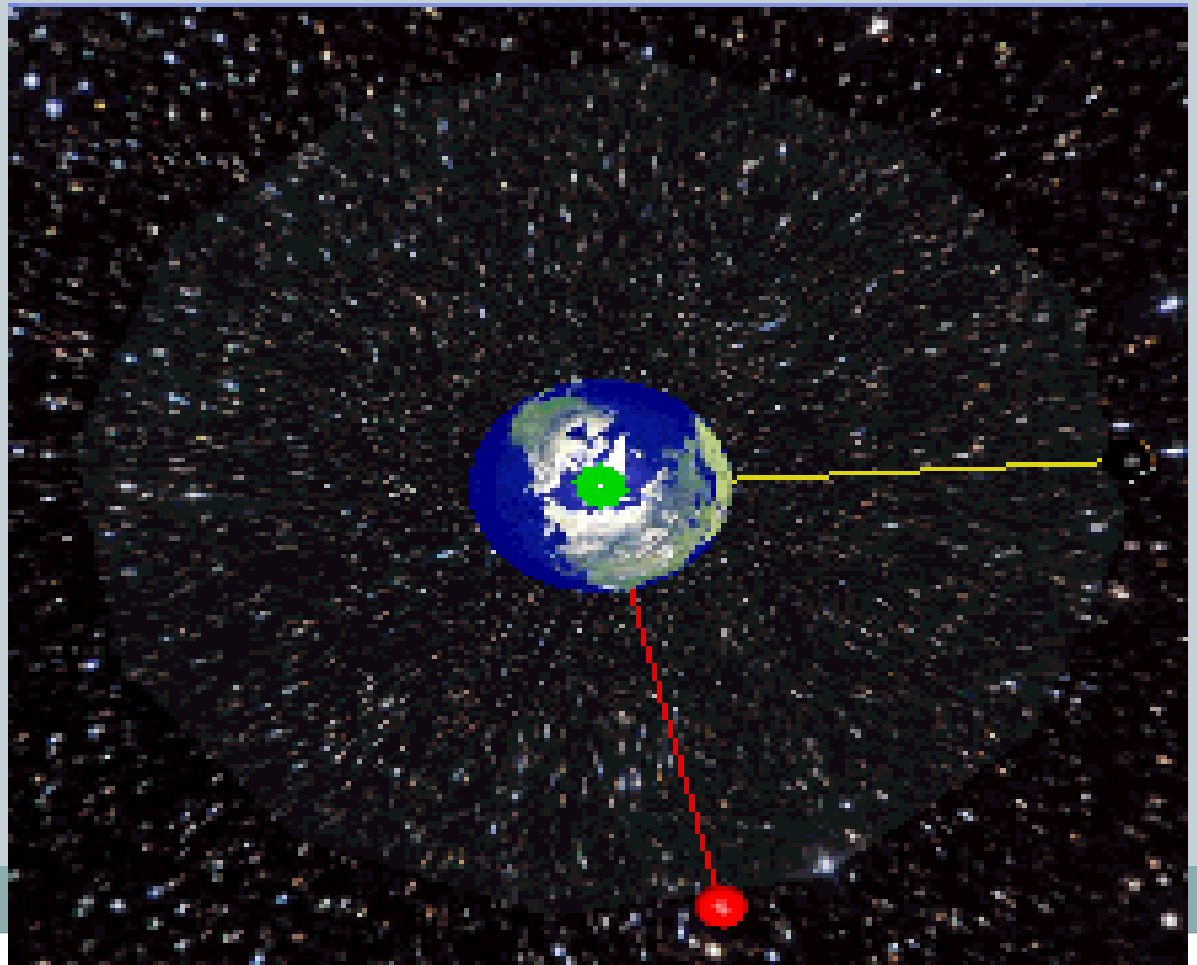
Types of satellite orbits

- Geosynchronous satellites(GEO)
- Low earth orbit satellites(LEO)
- Medium earth orbit satellites(MEO)

- **Geostationary (geosynchronous) orbits**:

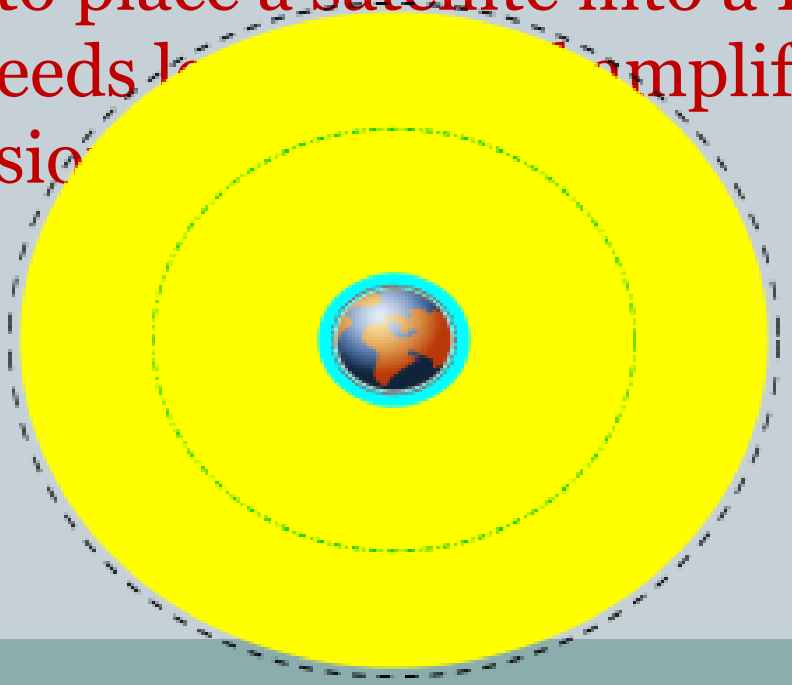
  An orbit which places the satellite above the same location at all times

  - Must be orbiting approximately 36,000 km above the Earth



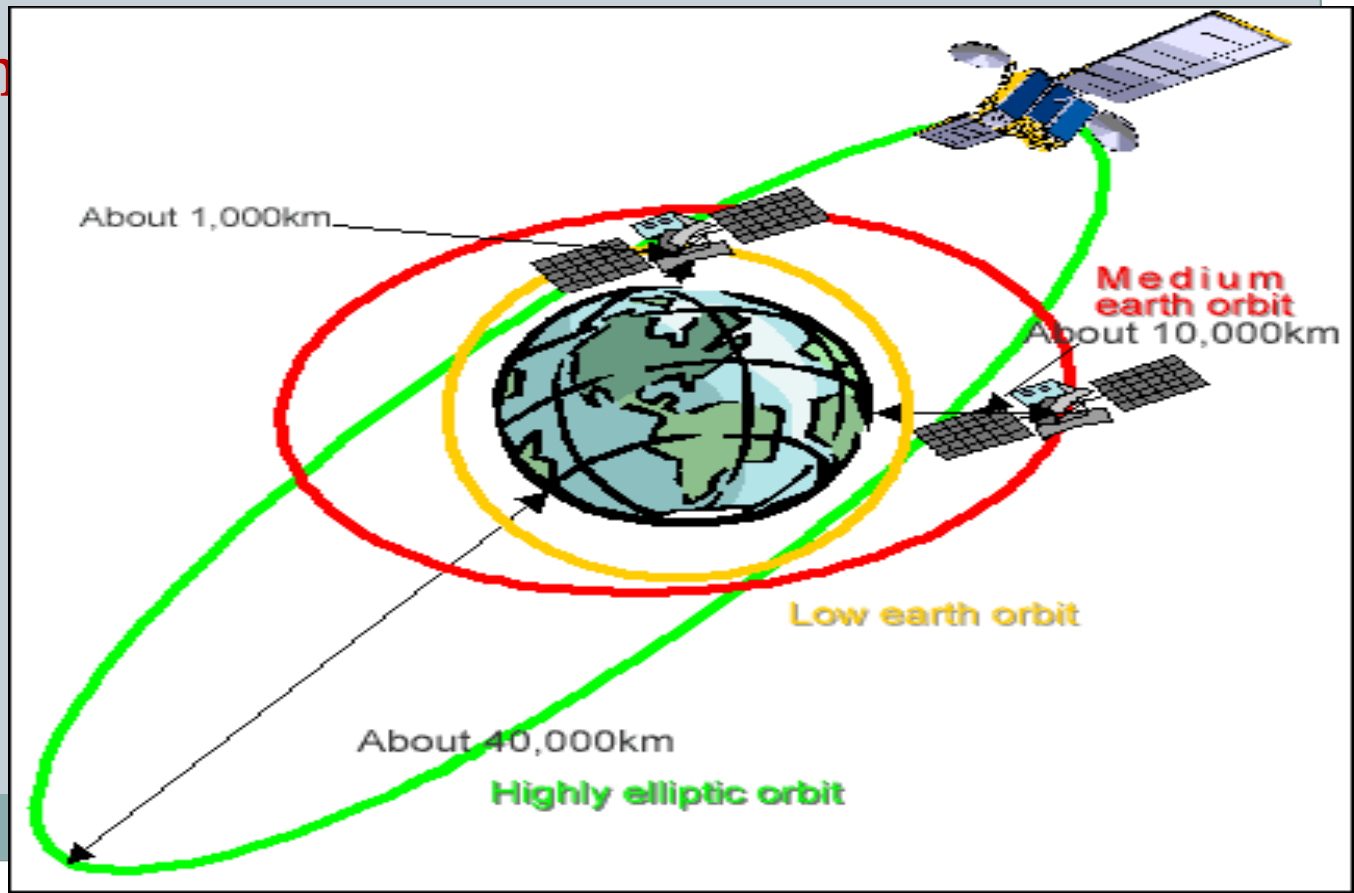
Low earth orbit satellites (LEO) :

- defined as an orbit below an altitude of approximately 2,000 kilometers.
- an orbit around Earth between the atmosphere
- it requires less energy to place a satellite into a LEO and the LEO satellite needs l mplifiers for successful transmissio



Medium earth orbit satellites (MEO):

- around the Earth above low Earth orbit(2,000 kilometres) and below geostationary orbit (35,786 kilometres)
- The most comm
for navigation

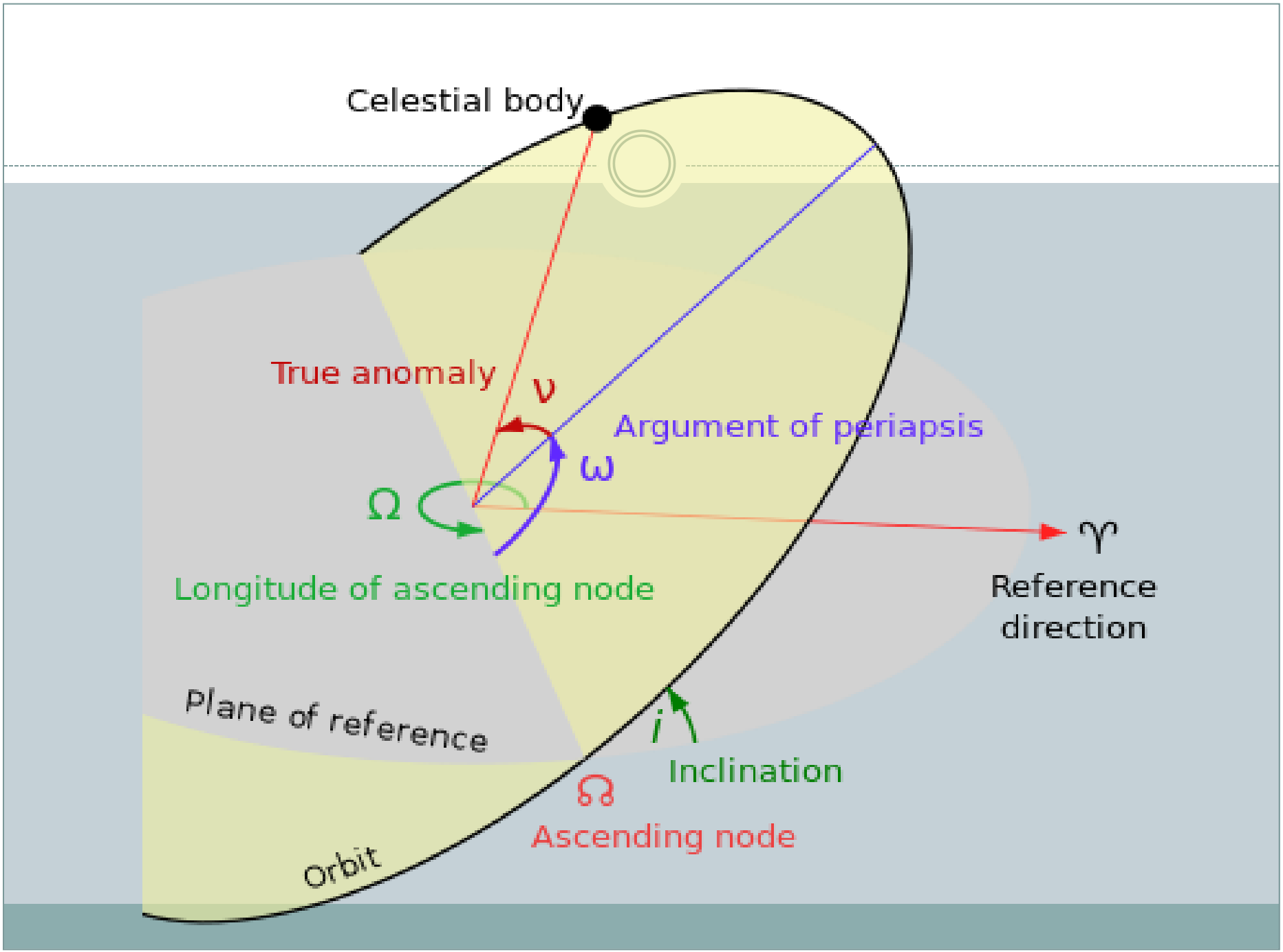


Synchronous orbits

- An orbit in which the satellite passes every location at the same time each day
  - Noon satellites: pass over near noon and midnight
  - Morning satellites: pass over near dawn and dusk
  - Often referred to as “polar orbiters” because of the high latitudes they cross
  - Usually orbit within several hundred to a few thousand km from Earth

ORBITAL ELEMENTS

- **Ω** Right Ascension of the Ascending Node
- **i** Inclination of the orbit
- **ω** Argument of Perigee
- **M** mean anomaly (epoch)
- **e** Eccentricity of the elliptical orbit
- **a** Semi-major axis of the orbit ellipse


Celestial body
True anomaly
ν
Argument of periapsis
ω
Ω
♈
Reference direction
Longitude of ascending node
Plane of reference
i
Inclination
☊
Ascending node
Orbit

KEPLER'S THREE LAWS

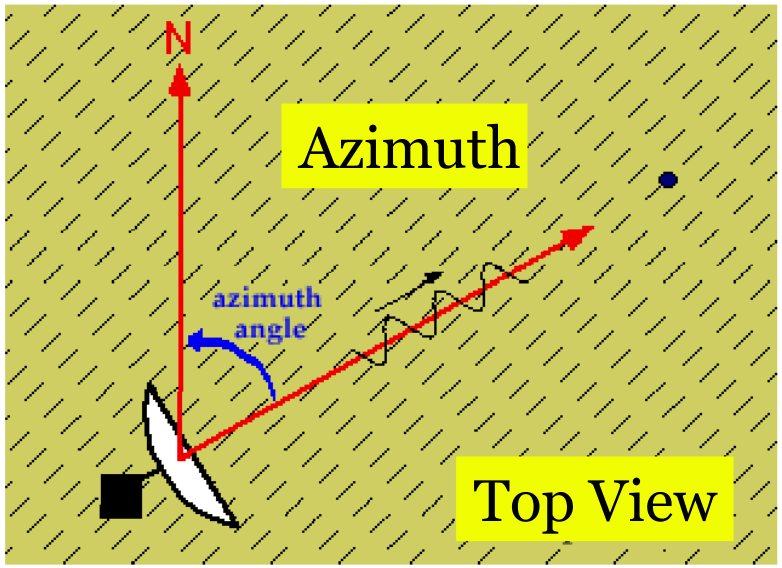
- Orbit is an ellipse with the larger body (earth) at one focus
- The satellite sweeps out equal arcs (area) in equal time (***NOTE***: for an ellipse, this means that the orbital velocity varies around the orbit)
- The square of the period of revolution is proportional to the cube of the mean distance between the two bodies.

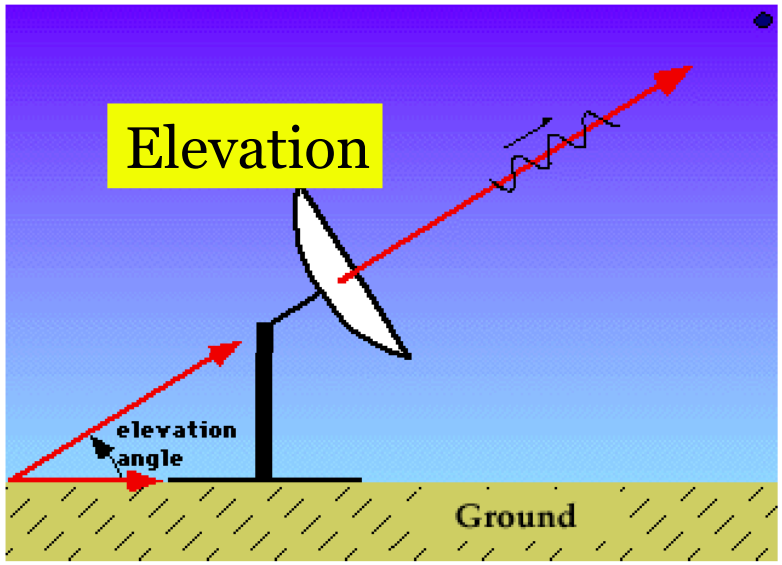

LOOK
ANGLE

Azimuth & Elevation Angles

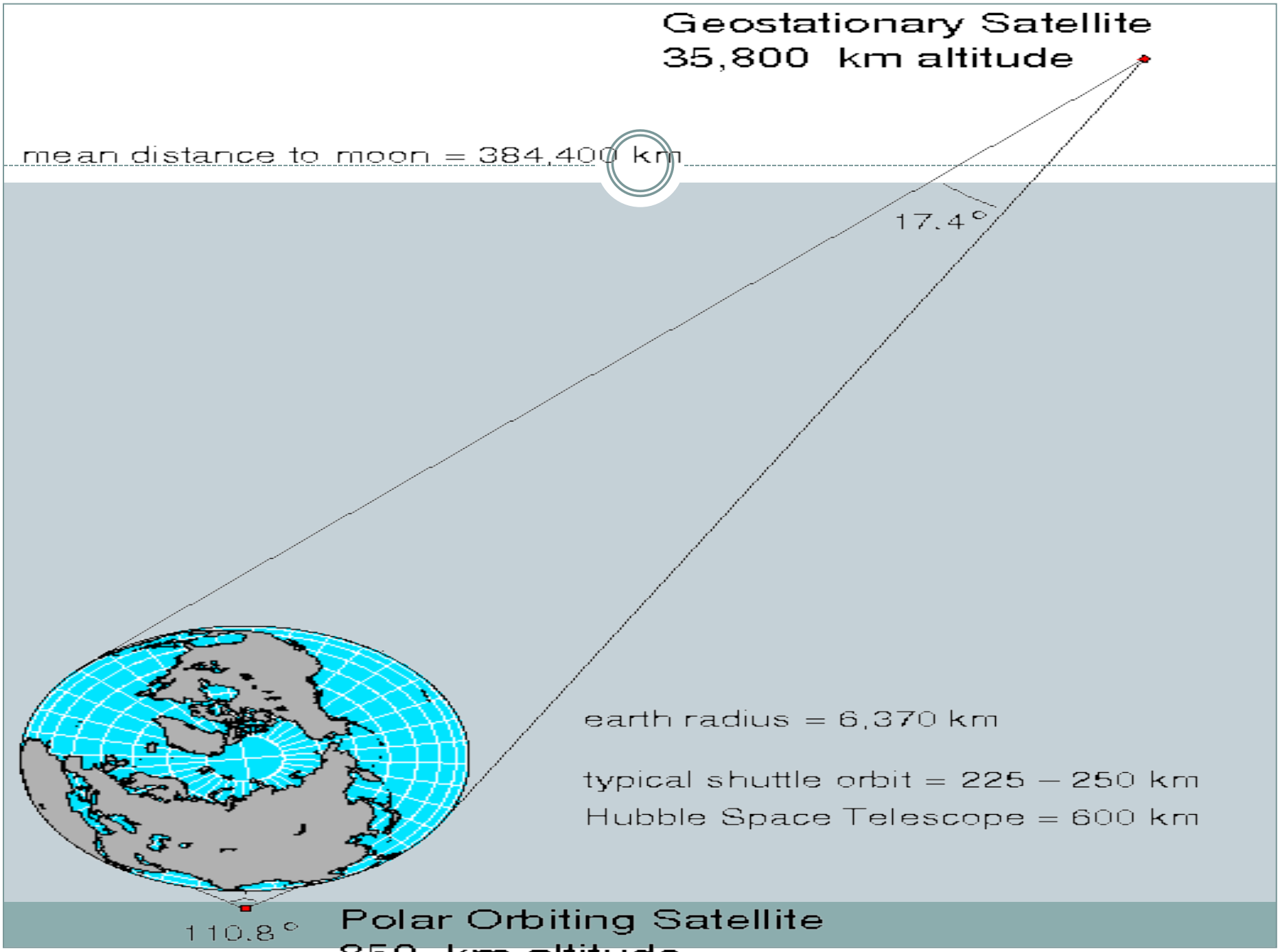
Azimuth is the axis of angular rotation

Elevation is the Angle with respect to the horizon -





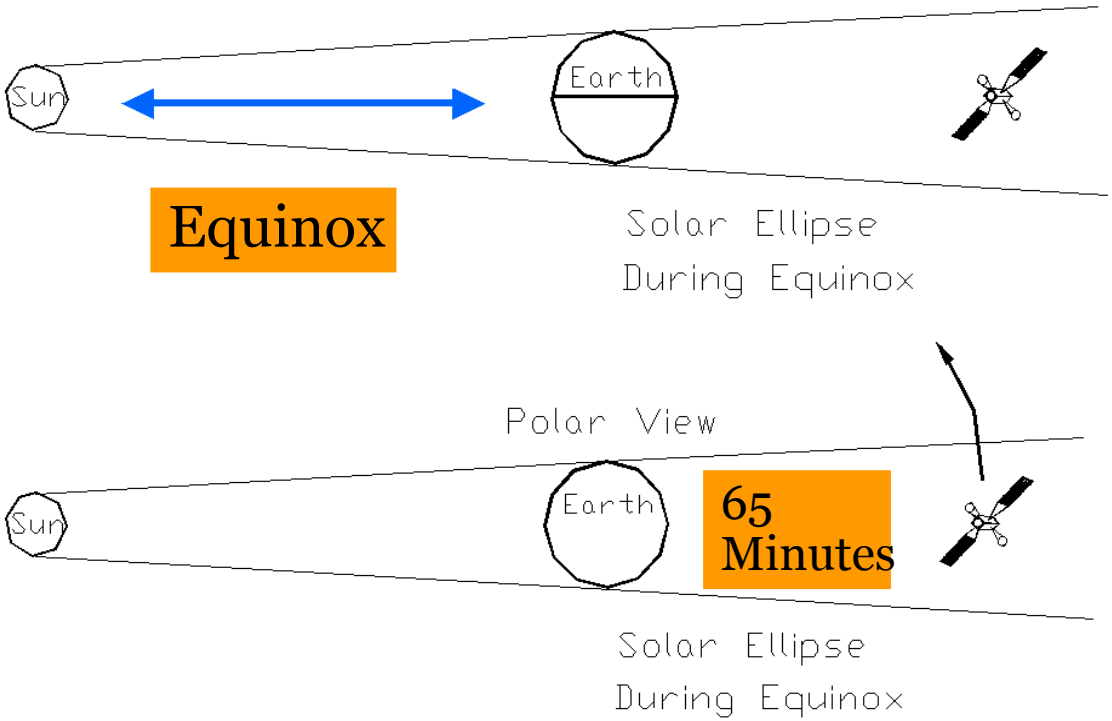
Earth Coverage and slant range


Geostationary Satellite
35,800 km altitude
mean distance to moon = 384,400 km
17.4°
earth radius = 6,370 km
typical shuttle orbit = 225 – 250 km
Hubble Space Telescope = 600 km
110.8°
Polar Orbiting Satellite
850 km altitude

Solar Eclipse

Satellites experience a solar eclipse two times a year Vernal & Autumnal equinoxes for about 6 weeks each year.

Satellites are in the earth's shadow for a few minutes to as much as 65 minutes on the day of the equinox.



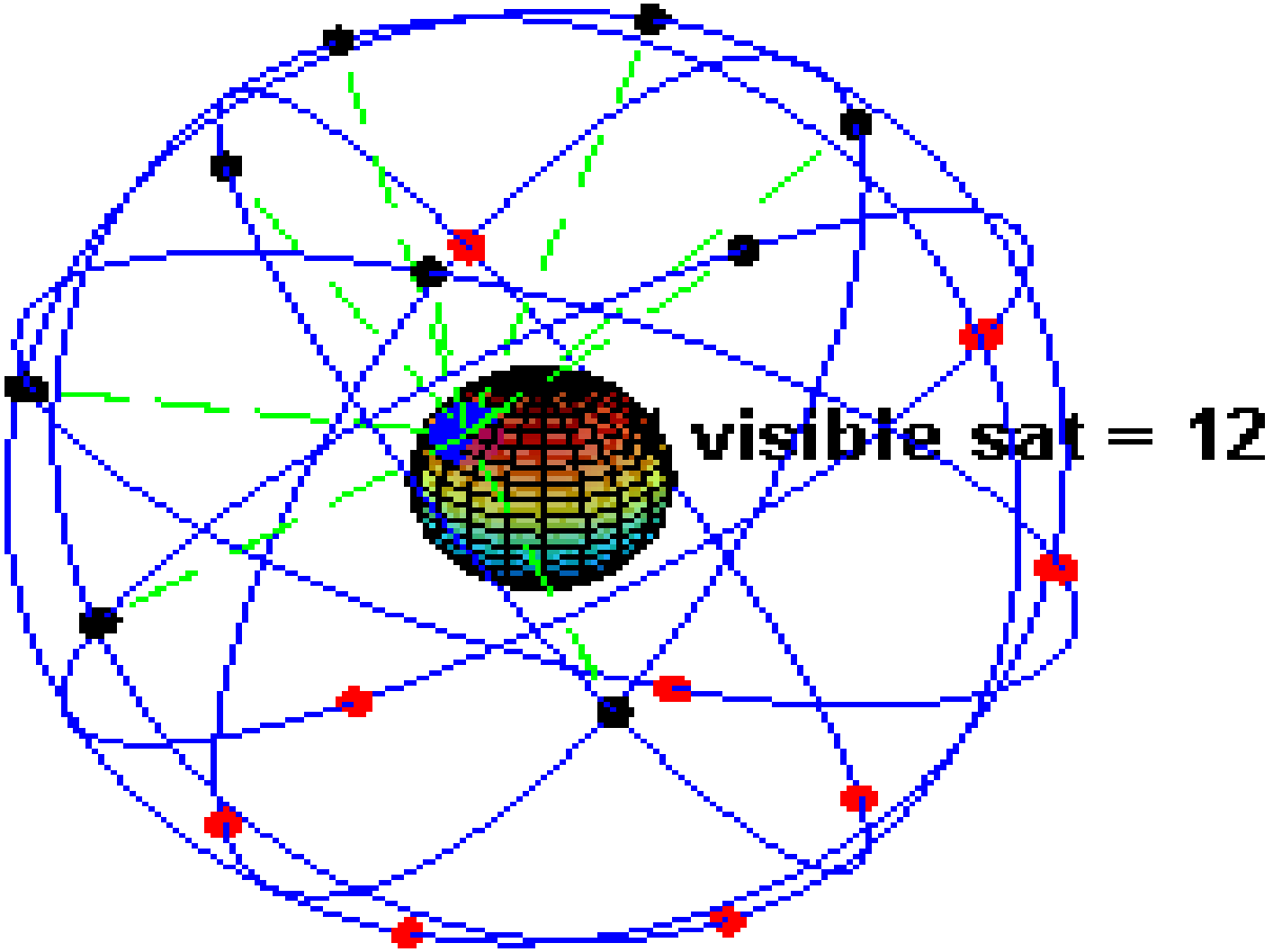
During Eclipse

-No Solarpower

-need battery power

-No Solarwarming

-Requires heaters.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