



Note: This file can not replace watching the video lecture. Because the video lecture contains more explanation through graphical elaboration.

Certified Junior Astronaut Training Course



Satellite Orbits (Part 2)





This lecture will answer the following inquiry:



What are the types of orbits? What is the suitable mission for each of them?





What are the types of orbits? What is the suitable mission for each of them?



- Each of the satellite missions has a working orbit that is suitable to its mission. For instance, a remote sensing satellite cannot be launched to the orbit of a communication satellite and vice-versa. Before being introduced to the appropriate working orbit for each mission, we should know the types of orbits.

Types of satellite orbits are classified according to four criteria:

- Classification according to altitude above the earth's surface.
- Classification according to the orbit shape.
- Classification according to the synchronization with Earth or Sun.
- Classification according to orbit inclination angle measured from the equator.





Cont.. What are the types of orbits? What is the suitable mission for each of them?



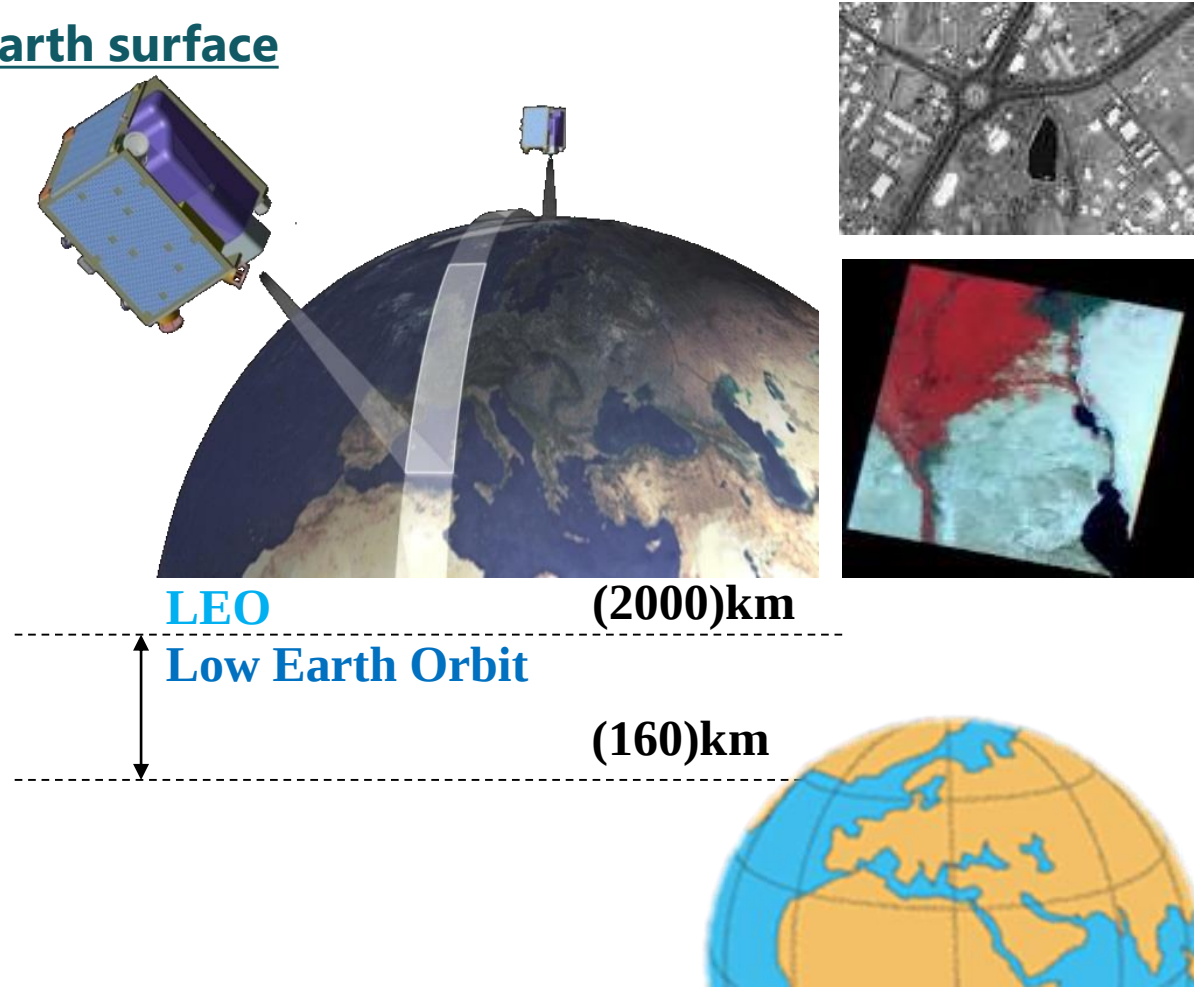
First: Classification according to elevation from the earth surface

Low Earth Orbit .. LEO

Altitude range is from 160Km to 2000Km above the earth's surface. It is the nearest orbit to earth and often used by remote sensing satellites which usually require being closer to earth surface to obtain images with the highest possible resolution.

The nearer the satellite is to earth surface, the clearer the captured image will be and the less coverage area on the ground. The farther the satellite is from earth surface, the more blurred the captured image will be and the more coverage area on the ground.

Most imaging satellites are located at an altitude of (500-800Km), taking into consideration that starting from altitude 300Km and lower, the effect of Perturbations gradually and greatly increases, which leads to decreasing their lifetime.





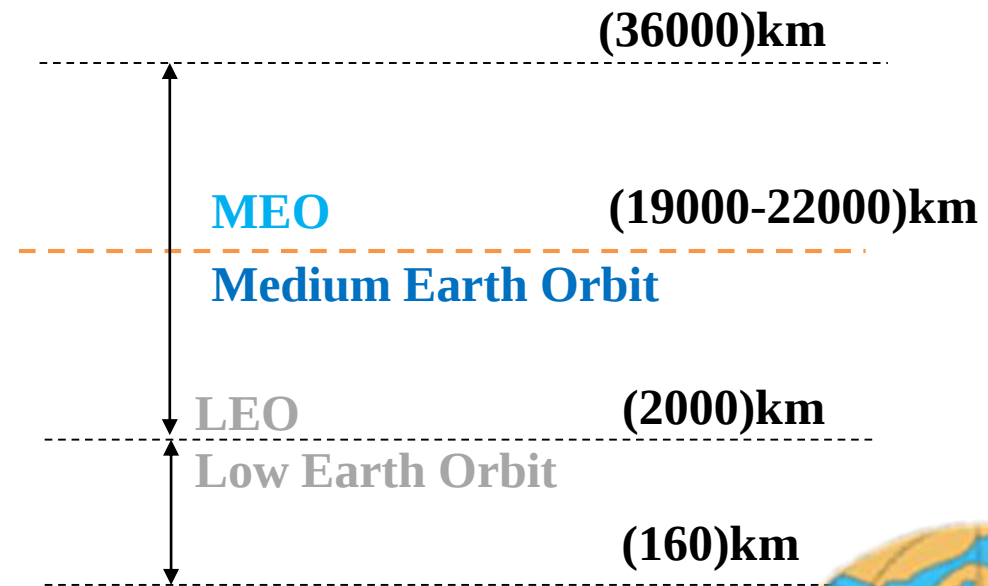
Cont.. What are the types of orbits? What is the suitable mission for each of them?



First: Classification according to elevation from the earth surface

Medium Earth Orbit .. MEO

- It is located above the Low Earth Orbit and its altitude ranges between 2000Km to 36000Km.
- It is used by Navigation Satellites which operate in a small part at an elevation that ranges between 19000 Km to 22000Km. Examples of these satellites include US Navigation Satellite series GPS, Russian GLONASS and European Galileo.



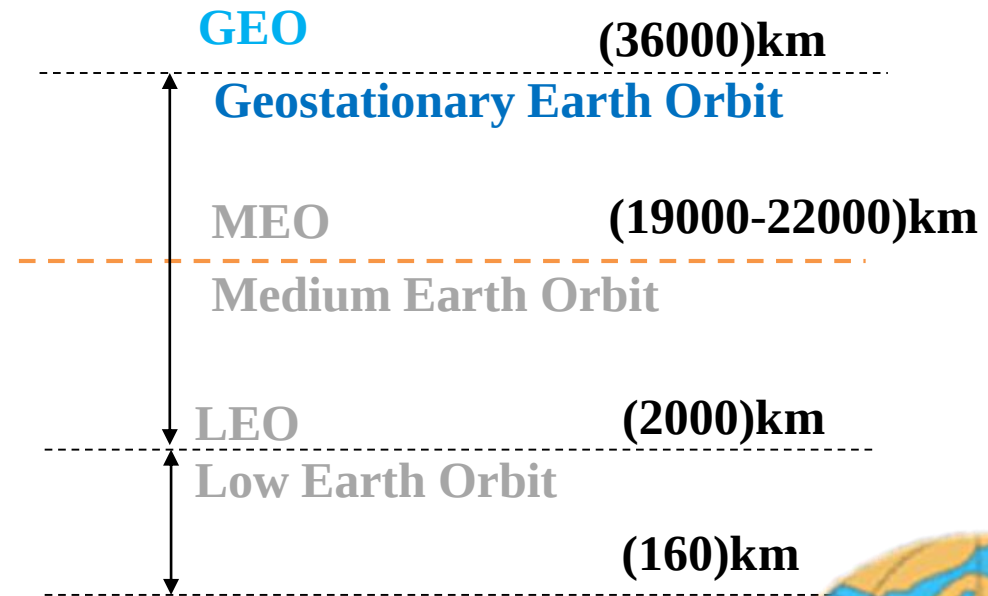


Cont.. What are the types of orbits? What is the suitable mission for each of them?



First: Classification according to elevation from the earth surface

Geostationary Earth Orbit .. GEO





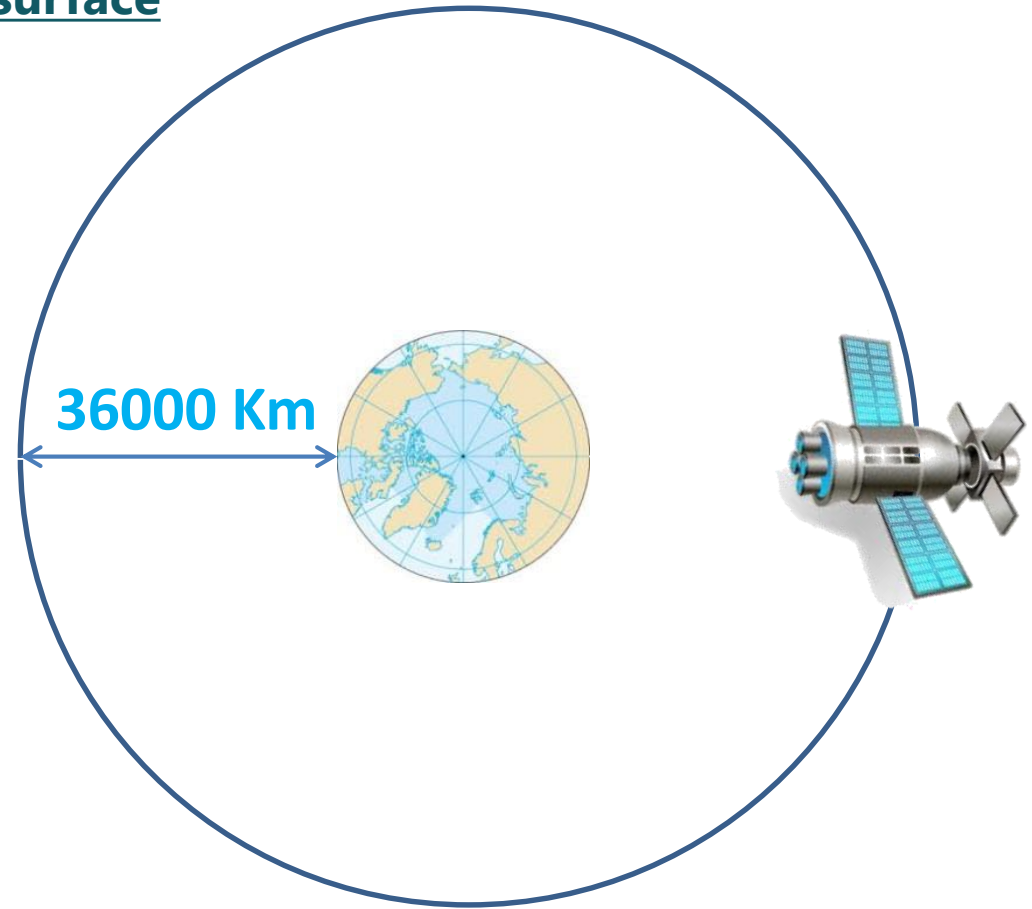
Cont.. What are the types of orbits? What is the suitable mission for each of them?



First: Classification according to elevation from the earth surface

Geostationary Earth Orbit .. GEO

- It is a circular orbit that surrounds the equator at a specific altitude of 36000Km (exactly 35786Km). This altitude has been determined according to Kepler's laws which clarify that the orbiting speed of a satellite decreases as it moves farther from earth and increases as it moves nearer to earth. At this specific altitude, the speed of a satellite rotation is equal to the speed of earth rotation. And hence a satellite can rotate around earth over a fixed point on the equator and seems to us as if it is stationary to earth.





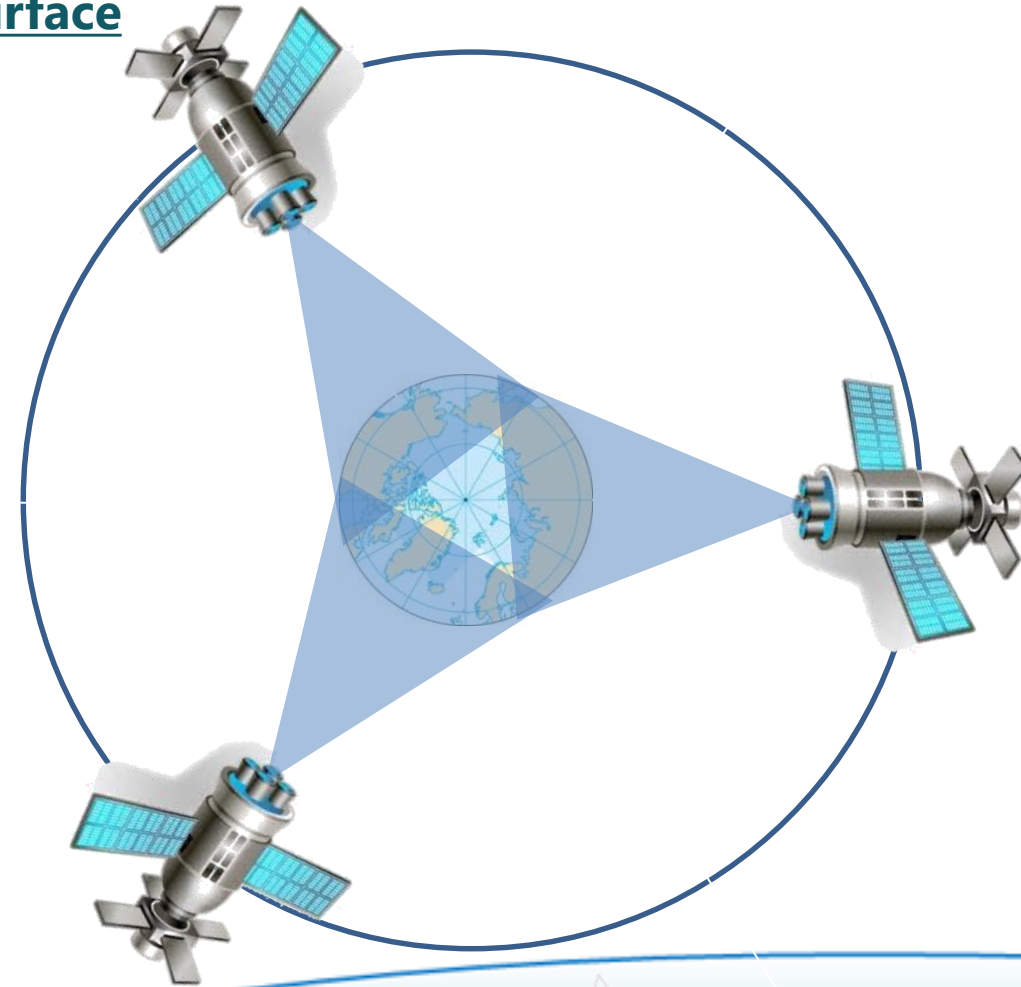
Cont.. What are the types of orbits? What is the suitable mission for each of them?



First: Classification according to elevation from the earth surface

Geostationary Earth Orbit .. GEO

- One satellite at this orbit can cover a circular area of about 42% of the earth surface. Thus; three satellites can cover the whole earth, except for the north area from latitude 81° North and towards the North Pole, and also the similar area at the South Pole. Communication satellites at this orbit cannot cover these Polar Regions.





Cont.. What are the types of orbits? What is the suitable mission for each of them?



First: Classification according to elevation from the earth surface

Highly Elliptical Orbit .. HEO

- It is an elliptical orbit with two altitude from the earth surface. The near altitude "Perigee" starts from 1000Km and more; while the far altitude "Apogee" starts from 36000Km and more.

36000Km and more

HEO

Highly Elliptical Orbit

Apogee



(1000)km

Perigee



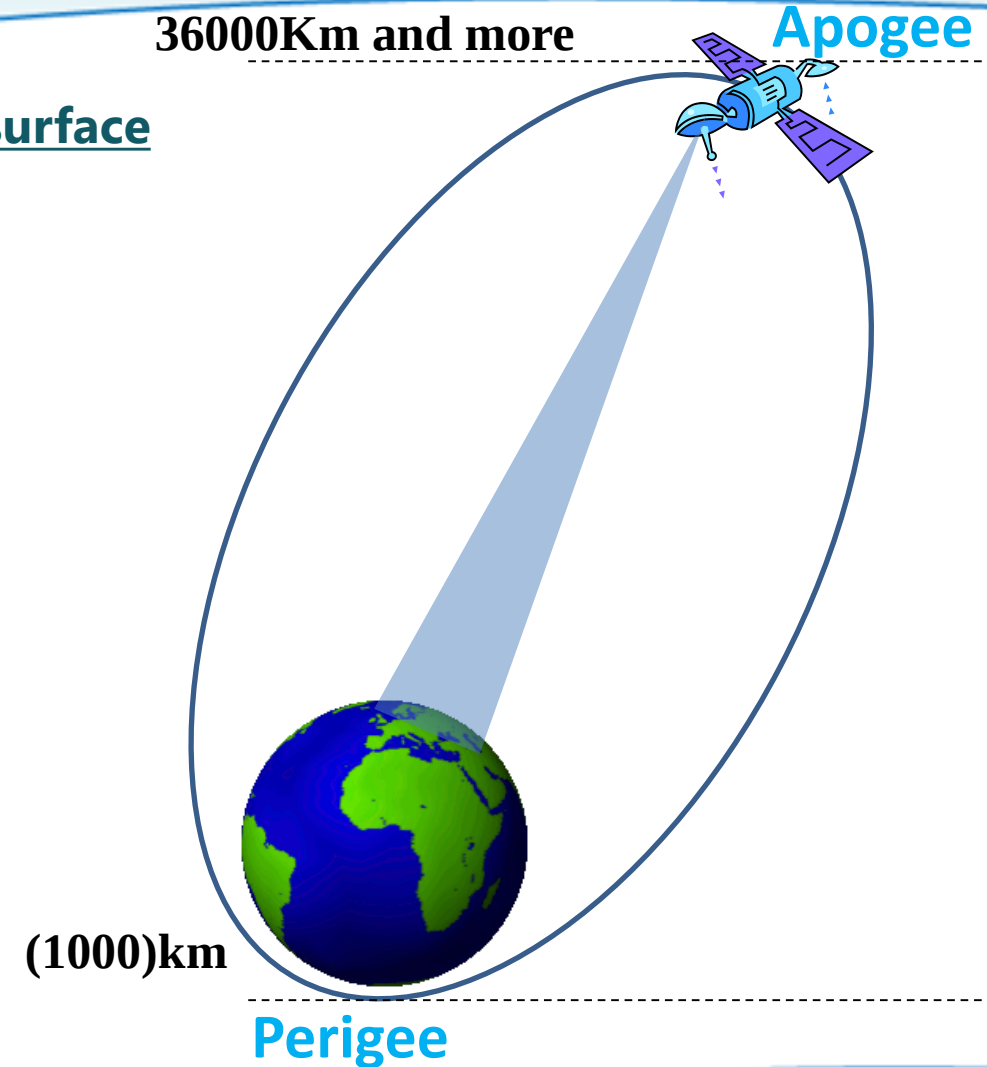
Cont.. What are the types of orbits? What is the suitable mission for each of them?



First: Classification according to elevation from the earth surface

Highly Elliptical Orbit .. HEO

- This orbit is usually used by satellites for covering the North Pole's countries that cannot be covered by the Geostationary Earth Orbit such as Norway, North Russia and Canada.
- The Apogee, which is the farthest point in the orbit from earth surface, is located above the North Pole. The speed of the satellite decreases when elevated and approaches this point. The satellite takes 12 hours per day above the North Pole to cover the communication there before completing its cycle. The satellite approaches earth at the Perigee where it rotates at its highest speed.
- Two satellites can cover the North Pole all day long; each of them should be located above the pole for 12 hours.





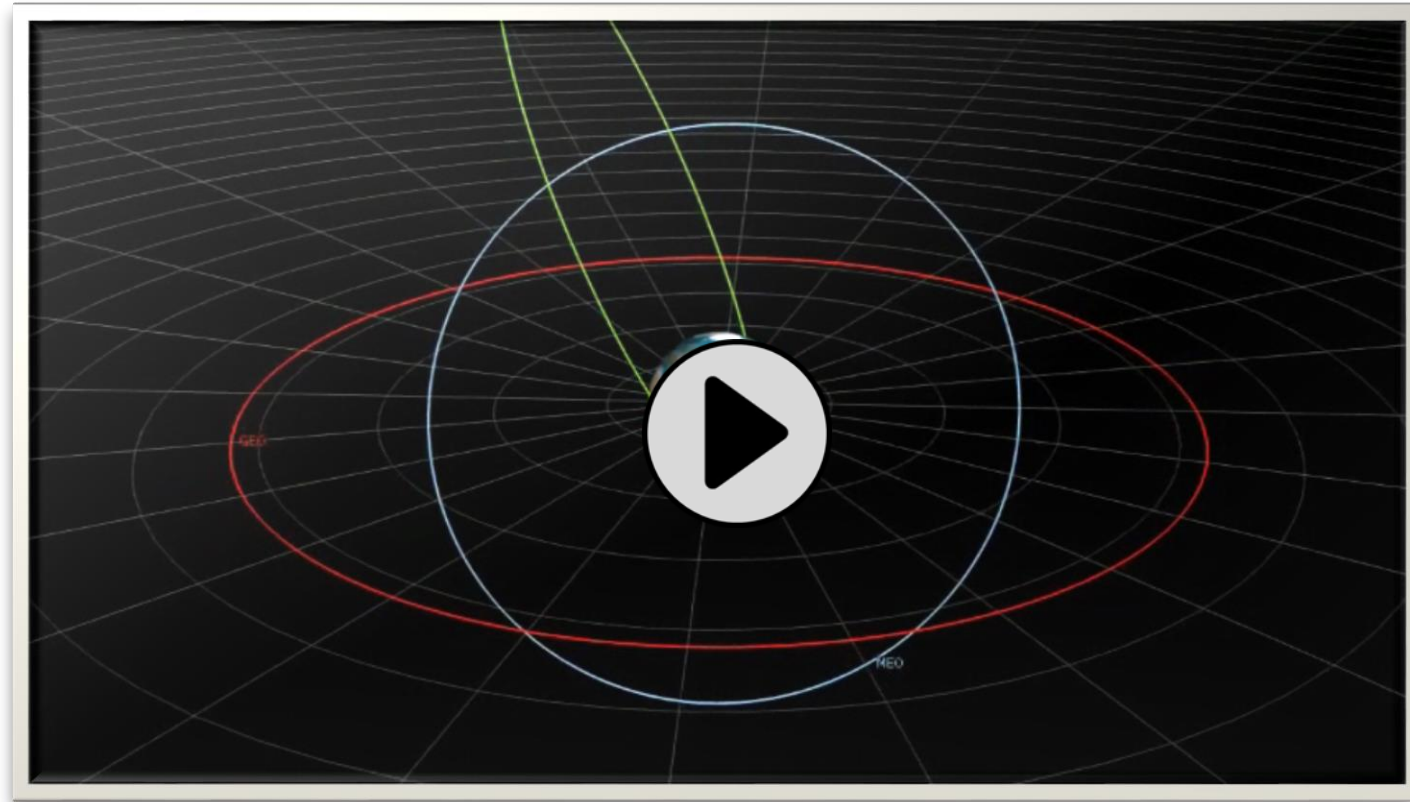
Cont.. What are the types of orbits? What is the suitable mission for each of them?



First: Classification according to elevation from the earth surface

The following video clip shows a summary of the previous types of orbits:

- Low Earth Orbit** is shown in orange and it is used by Remote Sensing Satellites and Space Stations.
- Medium Earth Orbit** is shown in white and it is used by Navigation Satellites.
- Geostationary Earth Orbit** is shown in red and it is used by Communications and TV Broadcasting Satellites.
- Highly Elliptical Orbit** is shown in green and it is used to cover communications in the North Pole and some observatories.



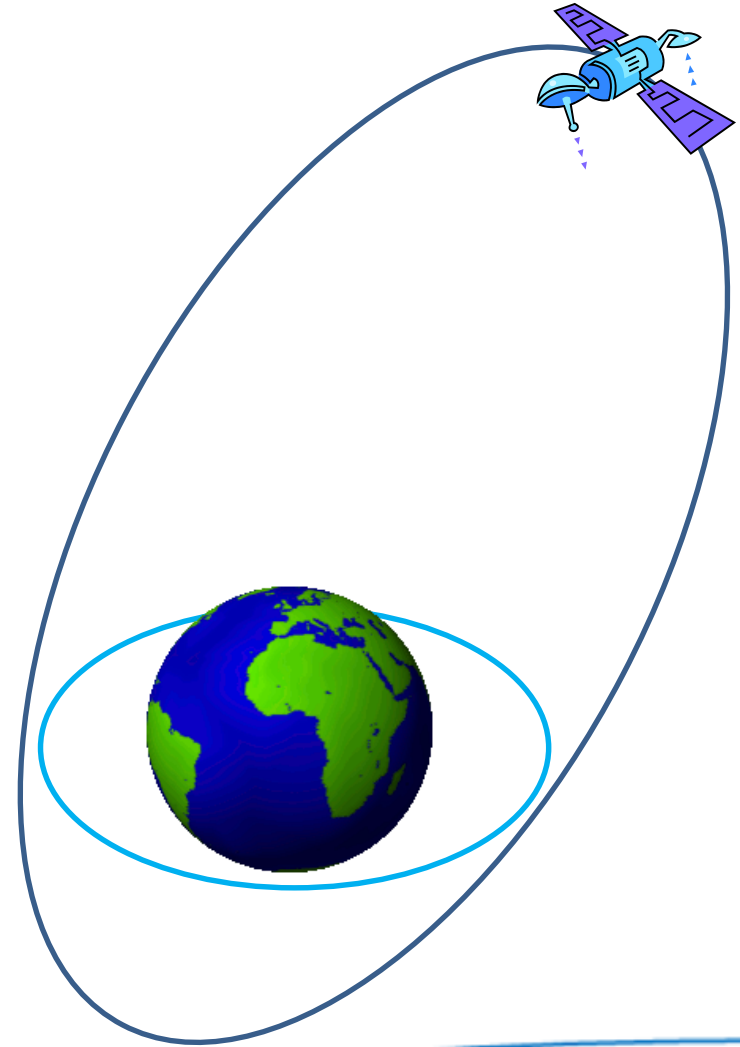


Cont.. What are the types of orbits? What is the suitable mission for each of them?

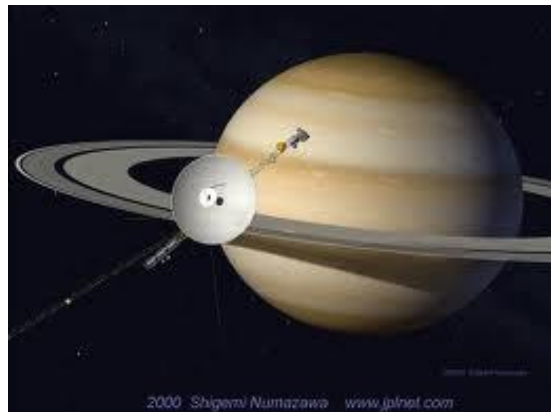


Second: classification according to the orbit shape

- + The shape of the orbit is classified into two main types; Closed Orbits and Open Orbits.
- + Closed Orbits: They are of circular or elliptical shape which are the shapes used by most satellite types.
- + Closed orbits mean the orbits in which the satellite returns after each cycle to its start point "Perigee"; in order to start the new cycle.



Cont.. What are the types of orbits? What is the suitable mission for each of them?



Second: classification according to the orbit engineering shape

- Open Orbits:** They are the opposite of Closed Orbits. Satellites don't return to the starting point. They have the shape of parabolic orbit or hyperbolic orbit. They have very special usages, such as; Space Probes orbits moving to other planets, disposing satellites by sending them away to the external space, space shuttle landing on earth, or landing on the moon surface.



Thanks for your undivided attention

