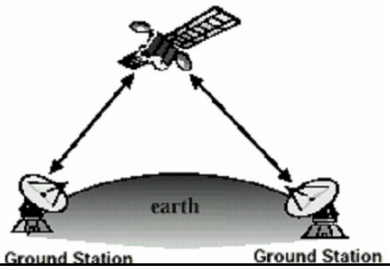
Communications Satellites

- Introduction
- Geostationary Satellites
- Medium Earth Orbit Satellites
- Low Earth Orbit Satellites
- Satellite vs. Fiber

Introduction

- A communications satellite is a _____
  - Receive at one frequency and _____
    - Broad beam _____
    - Narrow beam _____

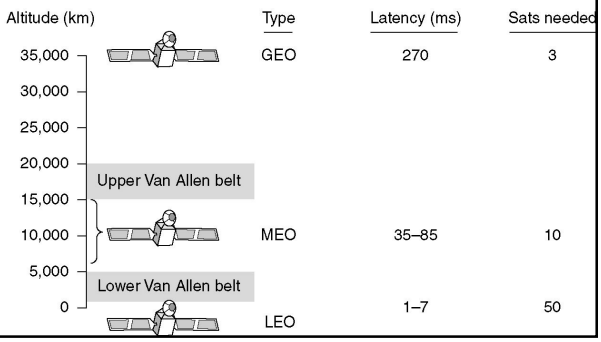


Issues

- Propagation delay: _____
- Broadcast media: _____
- Security: _____
- Cost: _____
- Errors: _____
- Deployment: _____

Satellite Placement

- $T^2 = r^3$
  - Near the surfaces of the earth the period is _____
  - At 35,800 it is _____
- Also need to avoid the Van Allen belts



Geostationary Satellites

- 2 degrees _____
  - Orbit allocation _____
- Station keeping _____
  - Lifetime is approximately _____
- Downlink transmission _____
  - Satellite bands: _____

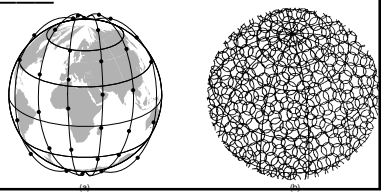
Band	Downlink	Uplink	Bandwidth	Problems
L	1.5 GHz	1.6 GHz	15 MHz	Low bandwidth; crowded
S	1.9 GHz	2.2 GHz	70 MHz	Low bandwidth; crowded
C	4.0 GHz	6.0 GHz	500 MHz	Terrestrial interference
Ku	11 GHz	14 GHz	500 MHz	Rain
Ka	20 GHz	30 GHz	3500 MHz	Rain, equipment cost

Medium Earth Orbit Satellites

- Between Van Allen belts
- 6 hours _____
- Smaller footprint _____
- Not currently used for telecommunications

Low-Earth Orbit Satellites

- Iridium
  - 77 (66) satellites _____
    - Cells _____
    - Channels _____
  - Satellites relaying traffic _____
  - Nov 1998: _____
  - Aug 1999: _____
  - March 2001: _____



Low-Earth Orbit Satellites (2)

- Globalstar
  - 48 LEOs _____
  - Uses bent-pipes: _____
- Teledesic (2005?)
  - 288 (30) LEOs _____
  - High bandwidth for Internet access _____
  - Packet switched _____
  - Uplink capacity _____
  - Downlink capacity _____

Satellites vs. Fiber

- Fiber wins _____
- Satellite niches
  - High bandwidth unavailable _____
  - Mobile communication _____
  - Broadcasting _____
  - No infrastructure _____
  - No right of way _____
  - Rapid deployment needed _____