Satellite Engineering

Outlines

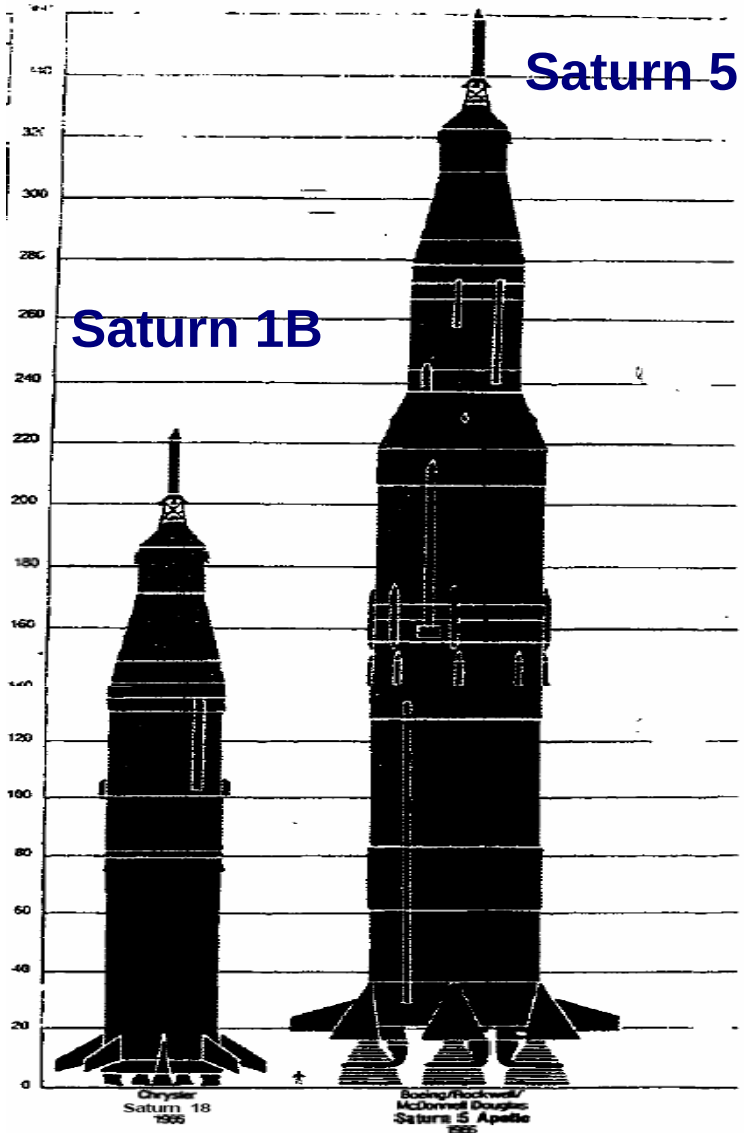
- Orbital Dynamics
- Launching
- Attitude Determination, control & Stabilization
- Thermal Design
- Spacecraft Power Subsystems
- Tracking Telemetry & Command
- Ground Support
- Spacecraft Structure

Orbit Orientation

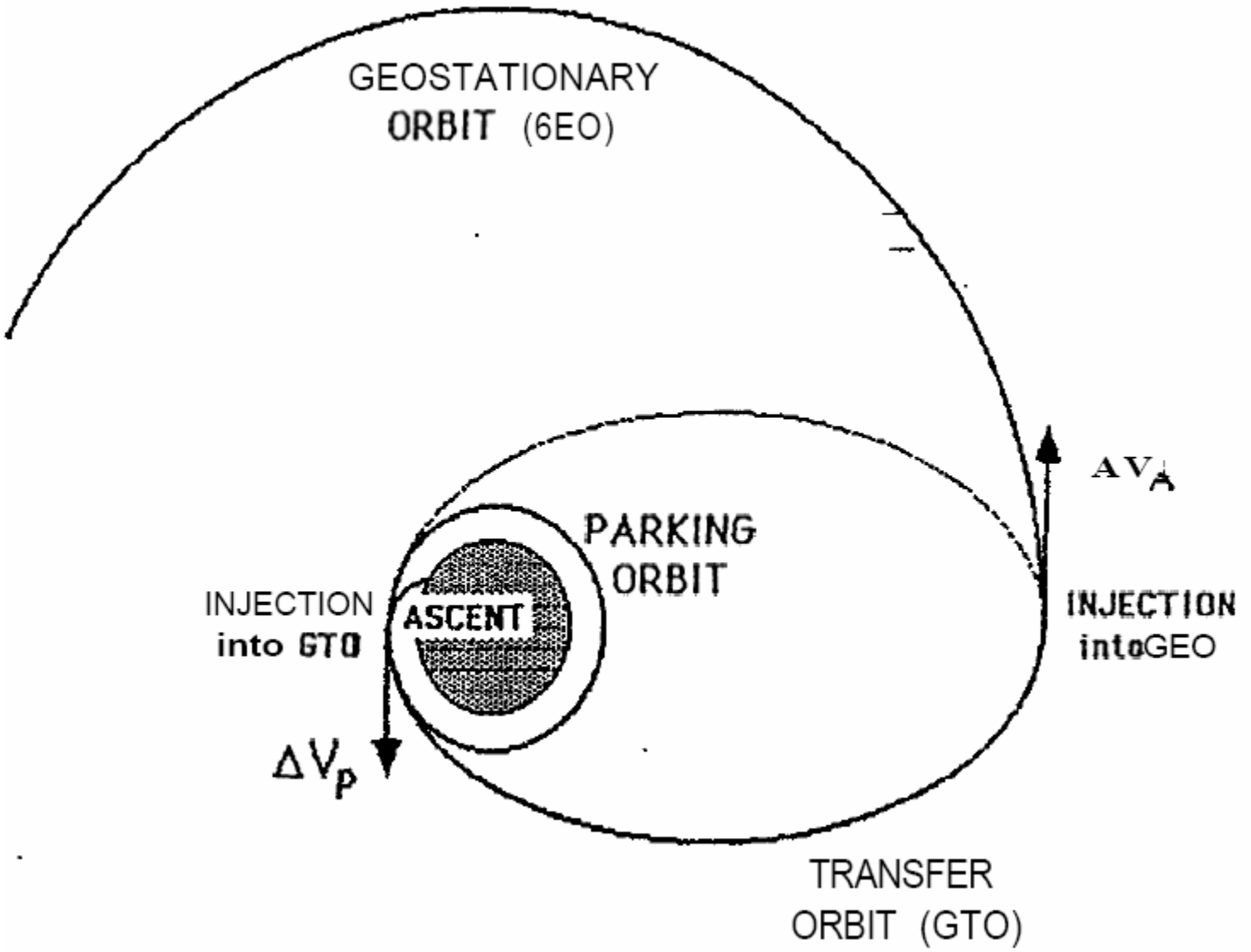
Prograde & Retrograde Orbits

Inclination	Orbit Type	Diagram
0° or 180°	Equatorial	
90°	Polar	
0° ≤ i < 90°	Direct or Prograde (moves in direction of Earth's rotation)	
90° < i ≤ 180°	Indirect or Retrograde (moves against the direction of Earth's rotation)	

Example of Launch Vehicles

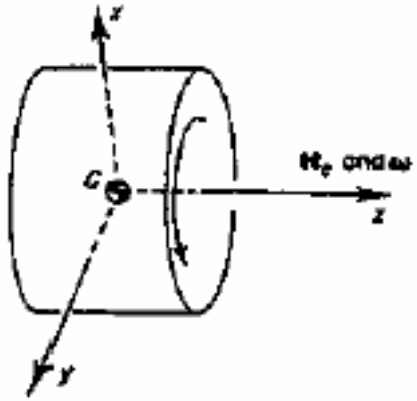


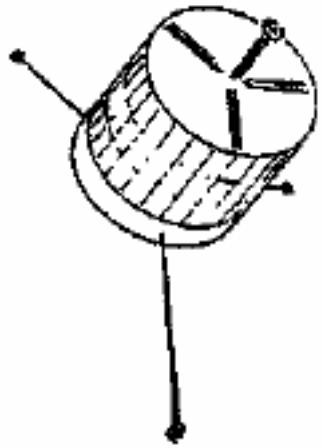
LAUNCH PROCEDURE



Spinning Spacecraft

- The behavior of spinning (or part-spinning) satellites (i.e. those with a significant momentum bias) is complex, but is still described by the *Euler equations.*
- Typically, we want to achieve *gyroscopic rigidity.* However, in order to do this we must take care to choose the correct *spin axis.*
- the spin axis must be along an *eigenvector of* the *inertia matrix,* or put another way, angular rotation vector (ω) must be about a *principal axis.*

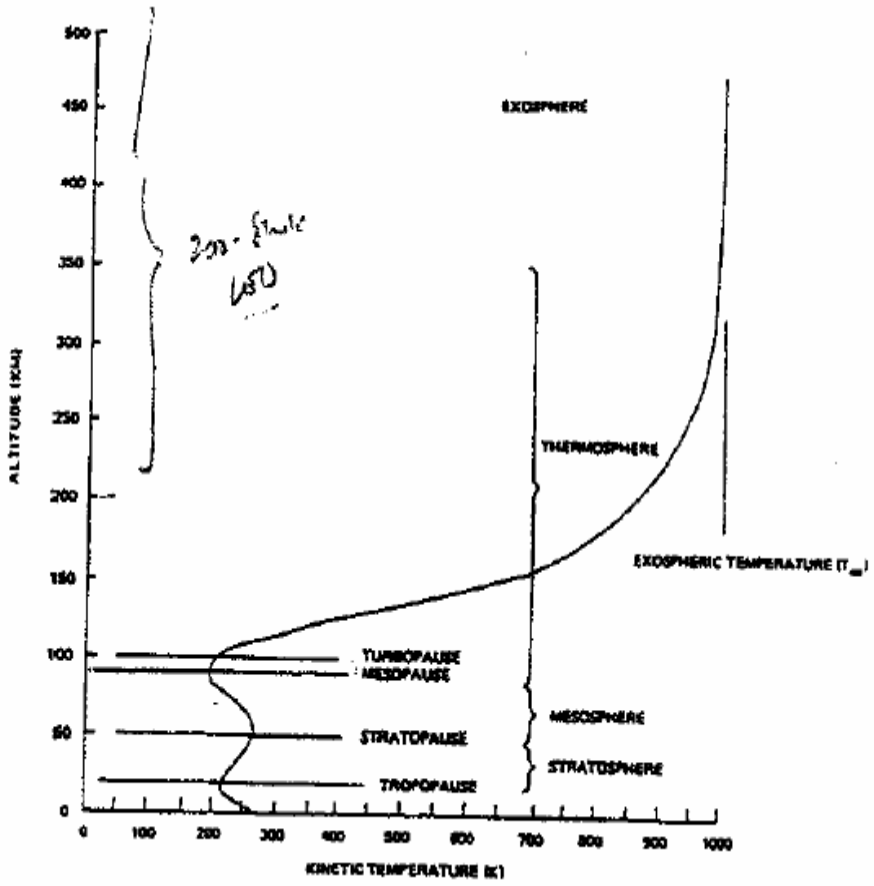




Spacecraft Thermal Design

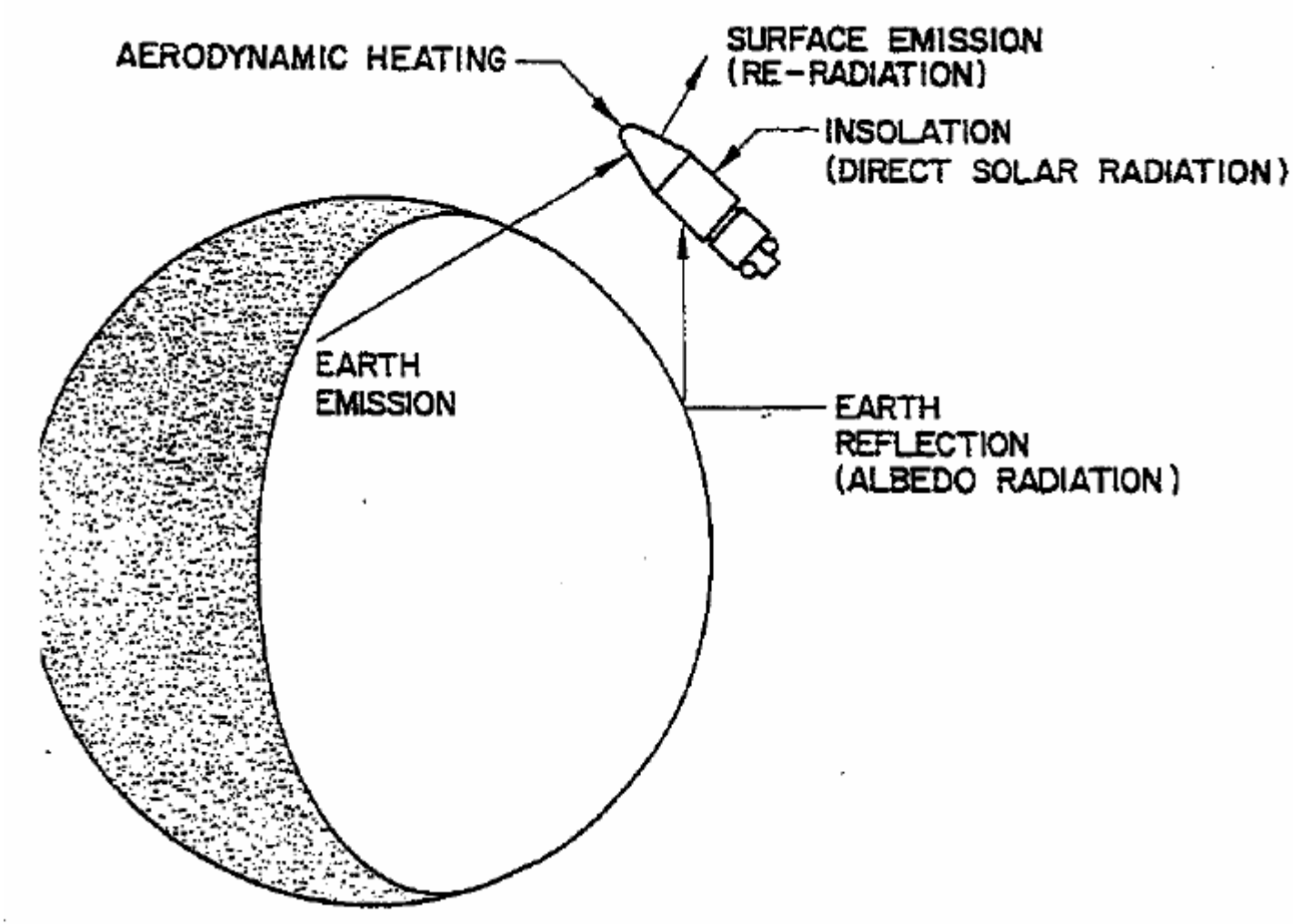
Factors Controlling Temperature:

- **In near-Earth space, the temperature of the residual atmosphere (Exosphere) is ~1000K(1273°C).**
- **However, spacecraft will not attain thermal equilibrium with the atmosphere as the free-mean path of the atmosphere's particles is much larger than the spacecraft dimensions,**
- **Heat Transfer is by radiation.**



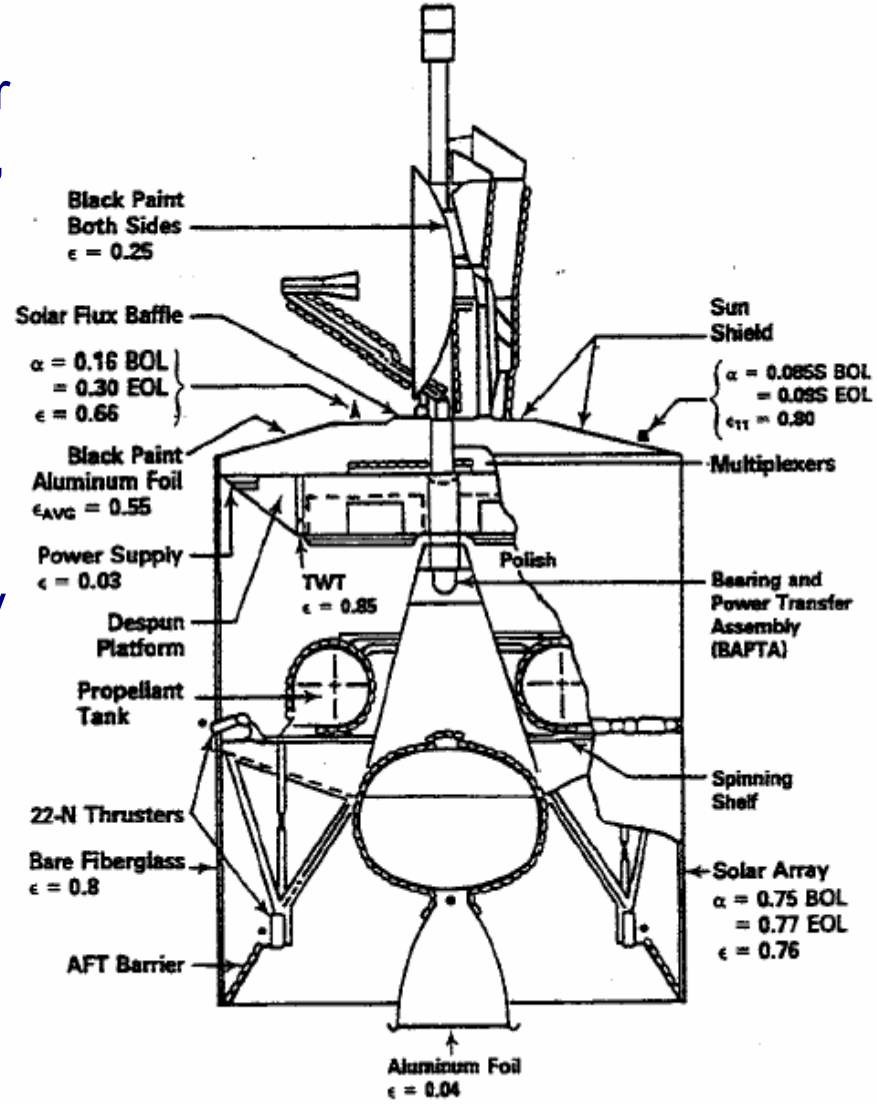
Spacecraft Thermal Design

Spacecraft Thermal Environment:

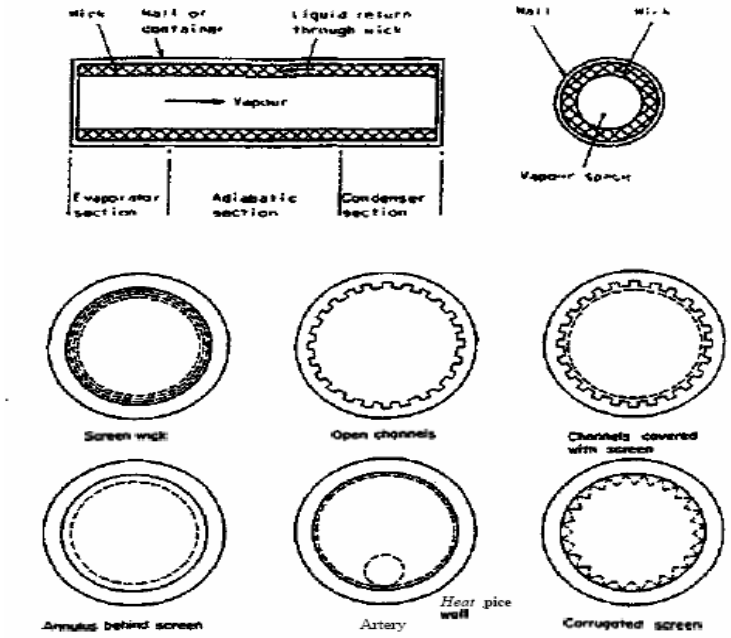


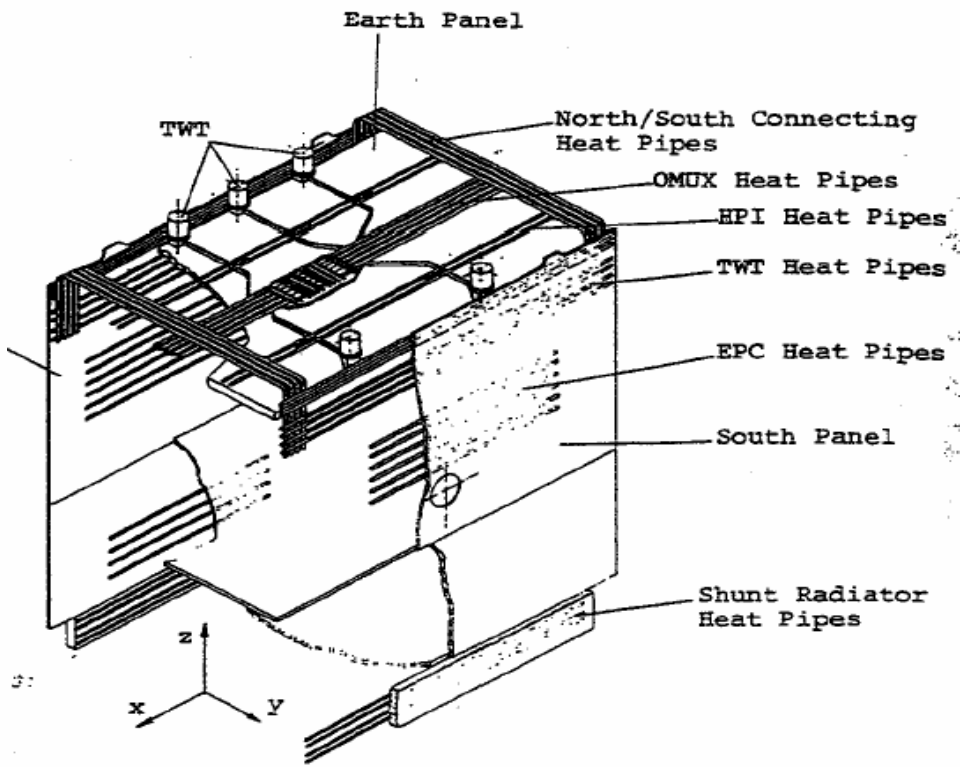
Active Control using Louvers

- Louvers consist of highly polished aluminum blades suspended on their ends along their length onto a frame, driven by bimetallic temperature sensors.
- The blades close at low temperatures to reduce heat lost to space.
- As the temperature increases, bimetallic temperature sensors apply torques that cause the blades to rotate to the open position increasing the heat rejected to space.
- Since the effective emittance to space changes with temperature, utilizing louvers greatly reduces any heater power requirements.

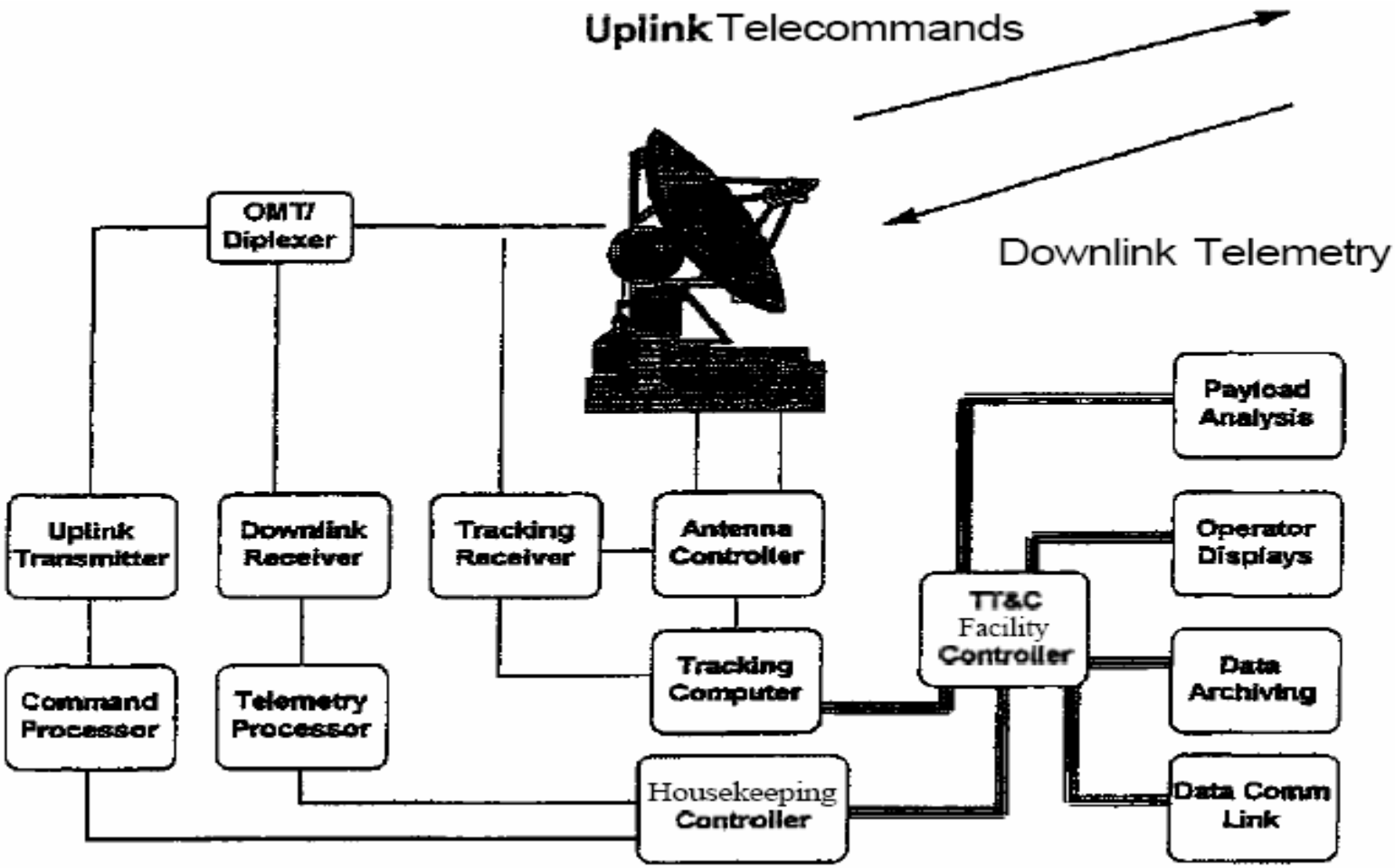


Active Control using Heat Pipes





TT&C Facility



Ground Support

- Design of the ground infrastructure depends upon

  - mission application

  - data distribution requirements

- Ground Support comprises a wide range of activities - before and after launch

  - Ground Test & launch campaign

  - In Orbit Test & commissioning

  - Earth Station Engineering