



Spacecraft Architecture

Timothy Canham
NASA Jet Propulsion Laboratory
October 16, 2023

Copyright © 2023 California Institute of Technology.
Government sponsorship acknowledged.

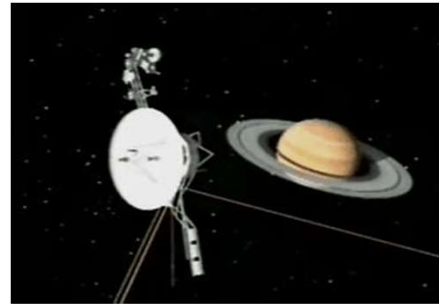


Jet Propulsion Laboratory
California Institute of Technology



Introduction to Spacecraft Architectures

- Many different kinds of spacecraft
 - Explorers
 - Communications
 - Weather
 - Military
 - Cubesats



Voyager



Asteria



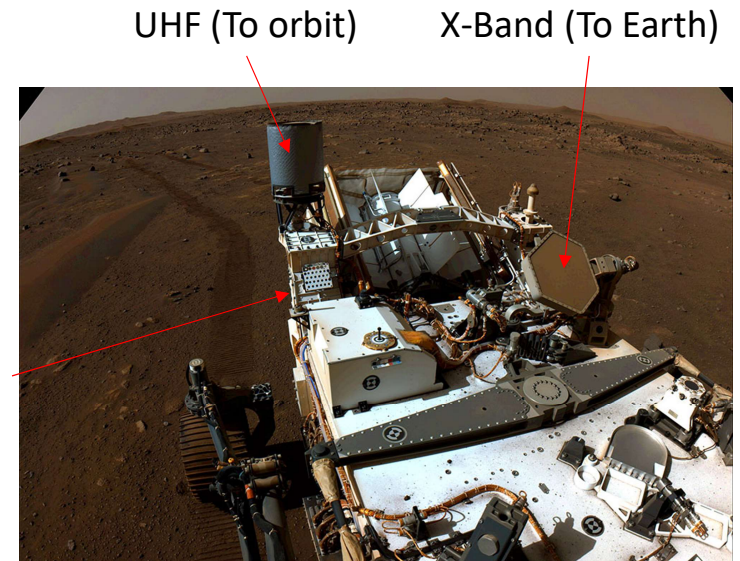
Iridium

Spacecraft Subsystems

- Propulsion
 - Thrusters (main, RCS)
 - Valves
 - Fuel delivery
- Telecom
 - Data encoding
 - Amplification and transmission
 - Reception
 - Radio Science
 - Antenna system



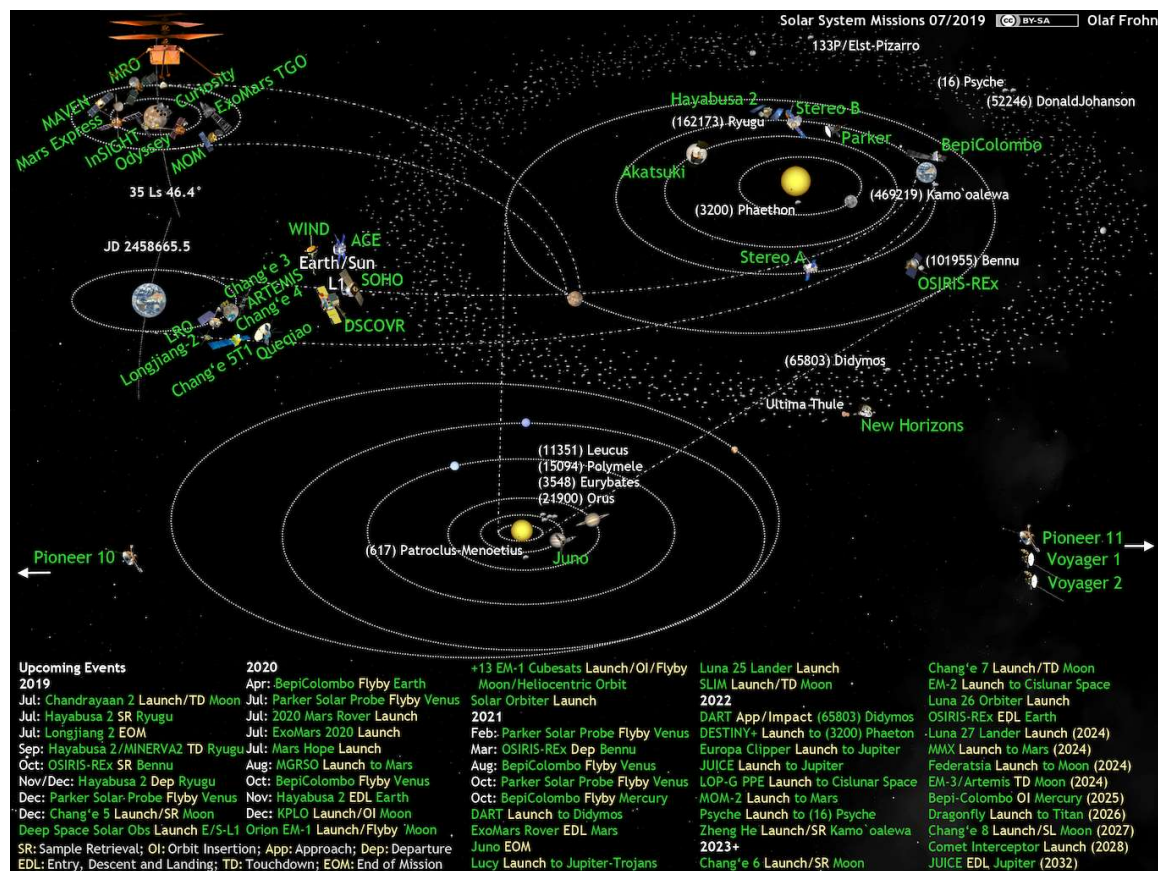
Saturn V



Perseverance Rover



Active Spacecraft



Other Spacecraft Architectures

- Payloads
 - Instruments
 - Radars
 - Experiments
- Deployables
 - Aerial Vehicles
 - Rovers



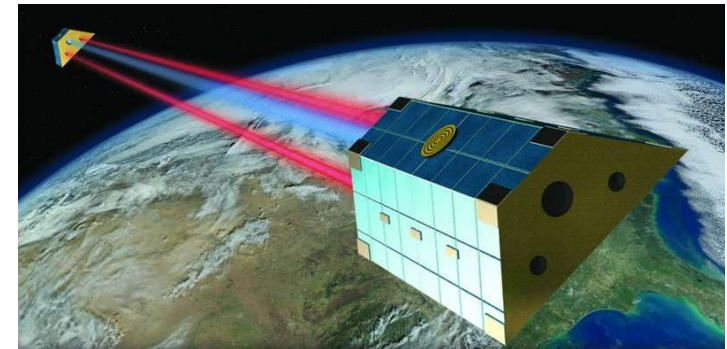
Ingenuity



Jason 2



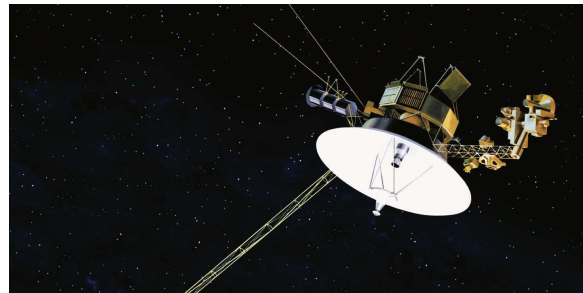
Cadre



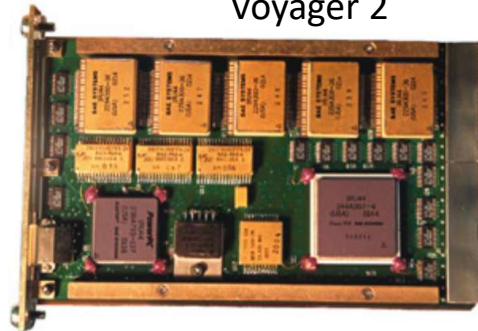
Grace Follow-On

Spacecraft Characteristics

- Characteristics of Spacecraft
 - Rugged
 - Survive for many years
 - Over-engineered
 - Old but reliable tech
 - Space-worthy
 - Radiation
 - Thermal
 - Power
 - Autonomous
 - Respond to faults
 - Guidance algorithms
 - Research on even more



Voyager 2

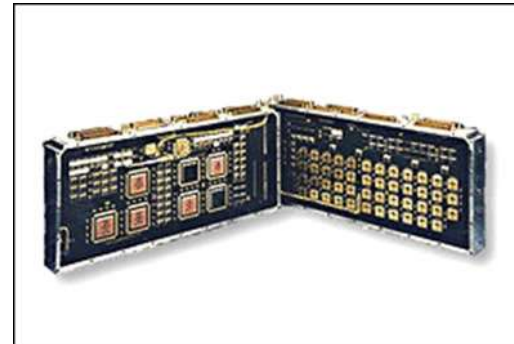


BAE
RAD750

Spacecraft Subsystems

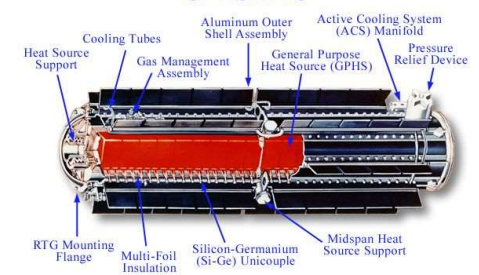
- Command and Data Handling (C&DH)
 - Computer processor(s)
 - Storage
 - Input/Output devices
 - UARTs, SpaceWire, SPI, I2C
 - Communication Busses
 - PCI, AMBA, 1553, VME
- Power
 - Power source
 - Battery system
 - Power switching

Cassini Flight Computer



Ingenuity Avionics

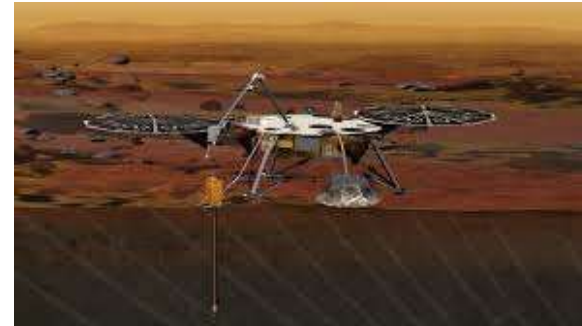
GPFS-RTG



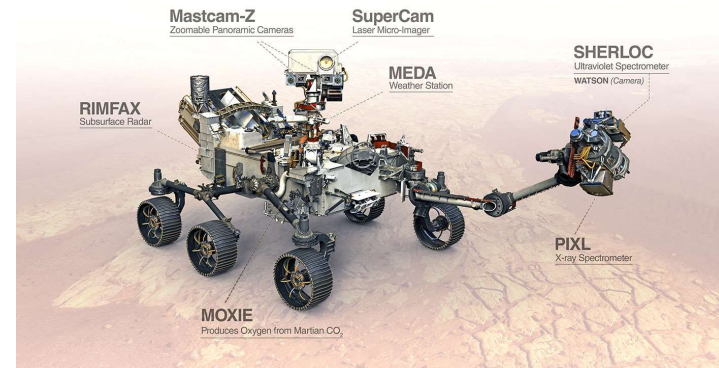
Spacecraft Subsystems

- Mechanical
 - Structure of the system
 - Rigid
 - Articulating
 - Rotating
- Payloads
 - Instruments
 - Sensors
 - Experiments
 - Imagers

Insight



Perseverance

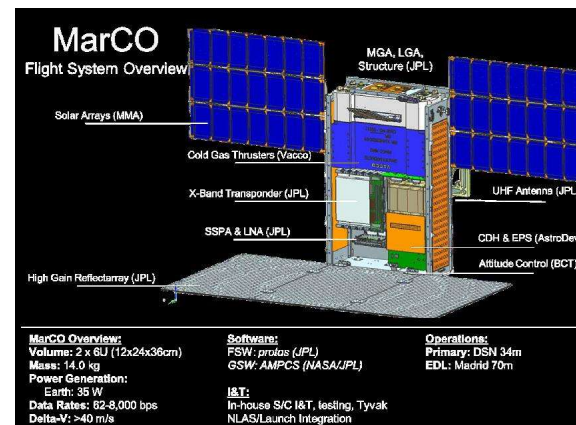


Spacecraft Subsystems – Hardware Layering

Peripheral
(Payload, Power,
Telecom, etc)

I/O
Device

Processor



MarCo Cubesat



References (shortened via bitly.com)

- Voyager - <https://bit.ly/2HTD0yK>
- Iridium - <https://bit.ly/2gFBaUb>
- Asteria - <https://go.nasa.gov/30TovDQ>
- Saturn V - <https://bit.ly/2HDOjvZ>
- Perseverance - <https://go.nasa.gov/3V8zN36>
- Active Spacecraft - <https://bit.ly/1K61I9C>
- Jason 2 - <https://bit.ly/2JIDjjh>
- Grace Follow-on - <https://bit.ly/2HXO3XF>
- Voyager 2 - <https://bit.ly/2vhOh3q>
- BAE RAD750 - <https://bit.ly/2JFgM6T>
- Cassini C&DH - <https://go.nasa.gov/2wlbttN>
- RTG - <https://bit.ly/1S8HHVF>
- Insight - <https://abcn.ws/2RadqsM>
- Kepler - <https://bit.ly/2EAwkoc>
- MarCo - <https://go.nasa.gov/2WtrAuN>