

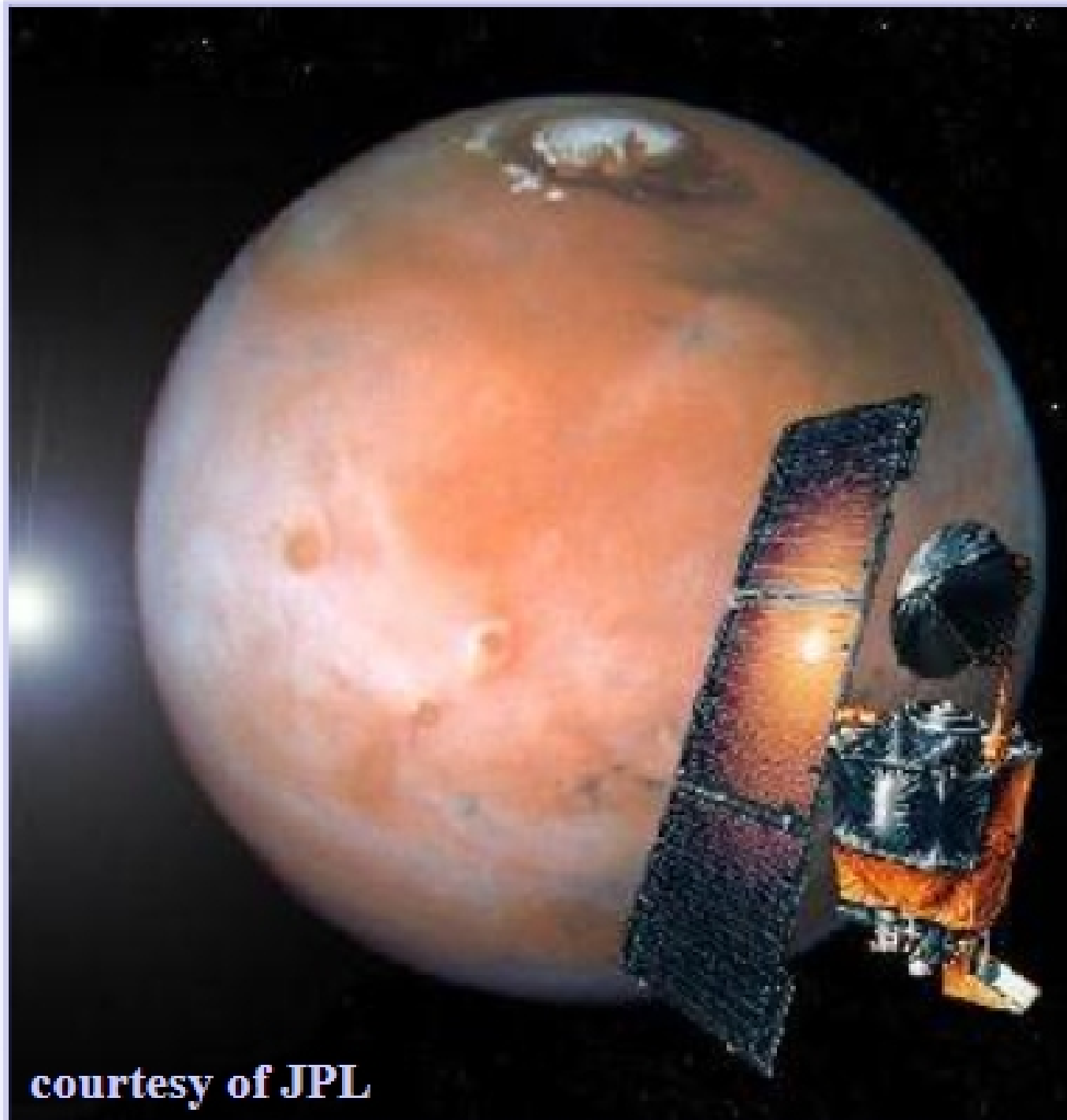
Model-based Programming: From Embedded Systems To Robotic Space Explorers

Brian C. Williams

CSAIL

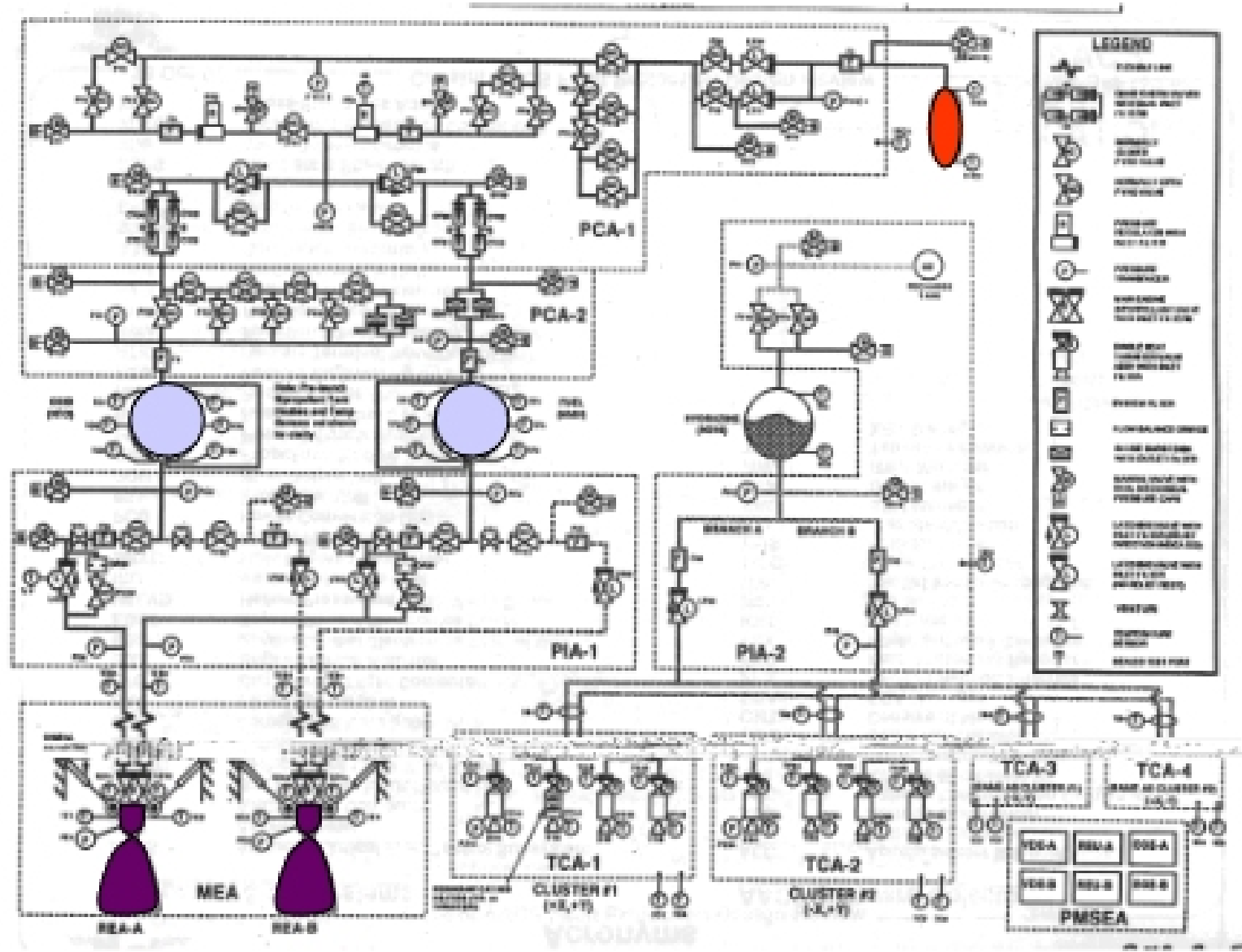
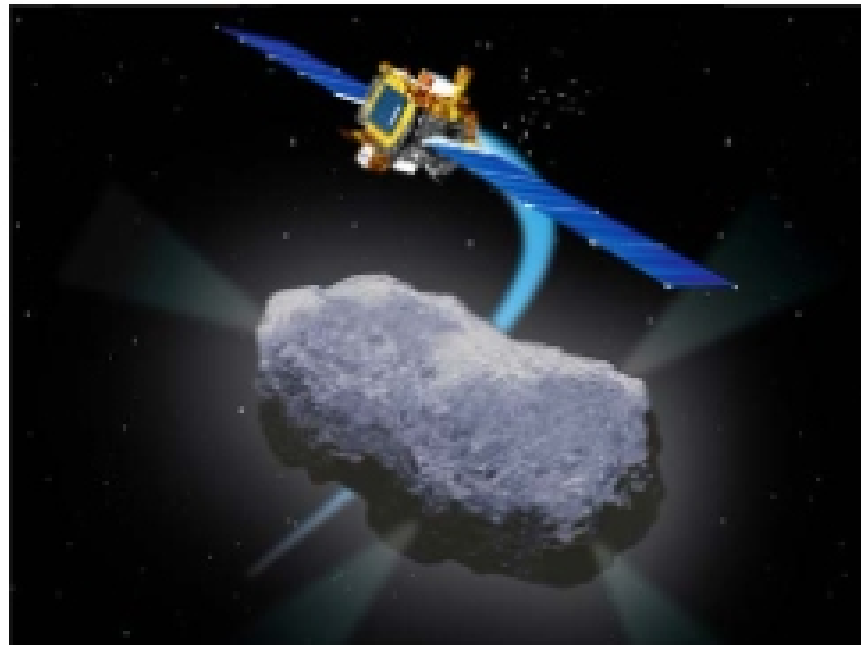
Massachusetts Institute of Technology

Failures Highlight The Challenge of Robustness



courtesy of JPL

- **Clementine**
- **Mars Climate Orbiter**
- **Mars Orbiter**
- **Mars Polar Lander**



Large collections of devices must work in concert to achieve goals

- Devices indirectly observed and controlled.
- Must manage large levels of redundancy.
- Need quick, robust response to anomalies throughout life.