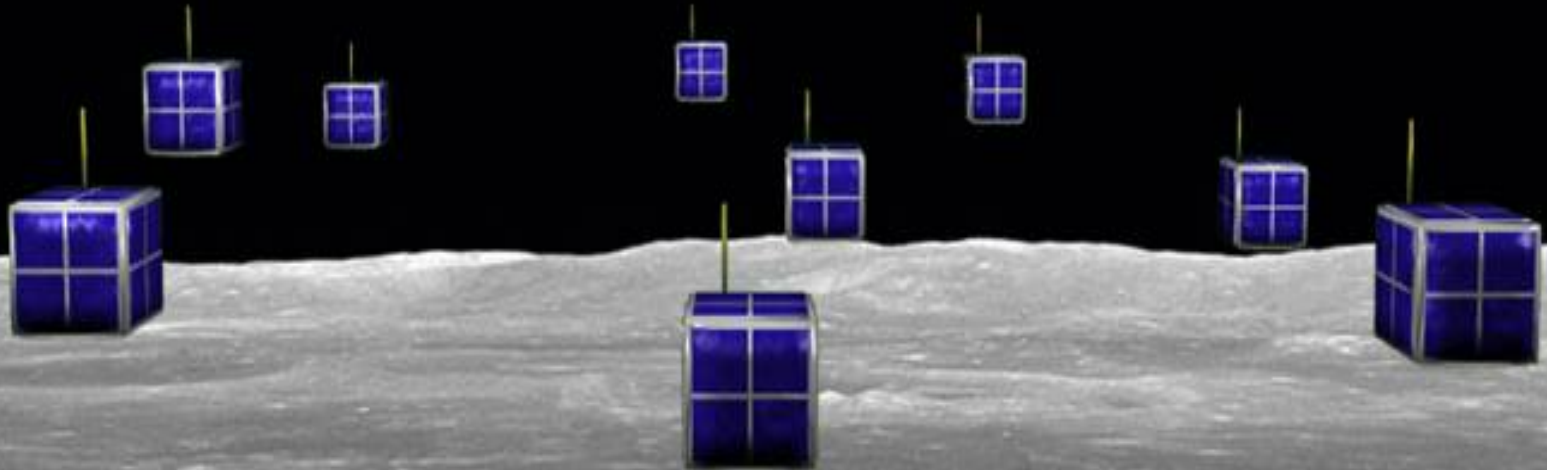


Stanford Lunar Analysis Mission: SLAM

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Prof. Bob Twiggs



Nov. 14, 2006
Stanford Amateur Radio Club



What is SLAM?

- Feasibility & preliminary design study
 - Can we send CubeSats to the Moon?
-

Keypoints

- ❑ *We can* send CubeSats to the Moon
 - ❑ Space Systems Development Lab (SSDL) future mission
 - ❑ Low power CubeSats and high power, high gain carrier
 - ❑ Hierarchical communication network
-

Motivation and Goals

Stanford on the Moon

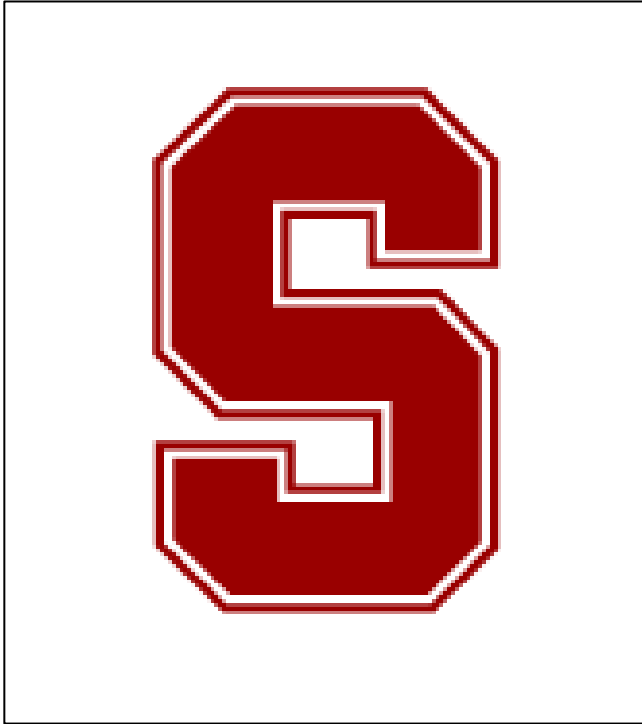
- Stanford alumni organization
 - Customer Goals
 - Multidisciplinary mission in next decade
 - Expand Stanford capabilities in space
 - Stanford initiative
 - Garner attention and fundraising for SOM future missions to establish Stanford presence on Moon
-

Lunar Mission Goals

- ❑ Satellite mission to Moon in next five years
- ❑ Collect data to further human missions
- ❑ Broadcast back to Earth
 - Beat Cal!
- ❑ Stanford science & engineering involvement



Lunar Mission Statement



- To design lunar satellite missions that can be carried out in large part by the Stanford community
- Determine existing Stanford infrastructure and capabilities

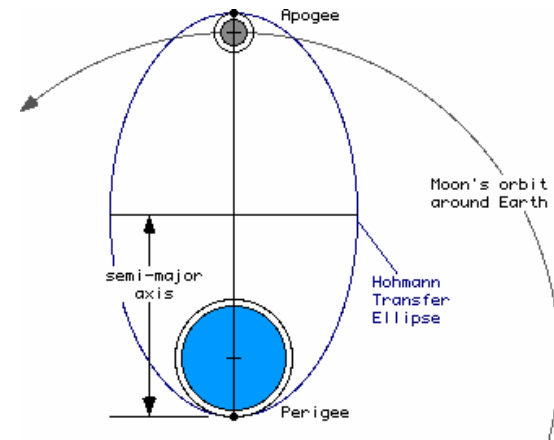
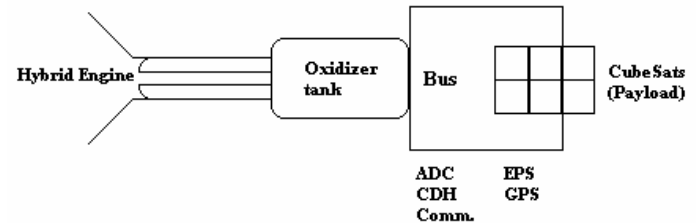
Why Do It?

- ❑ Educational opportunity
 - ❑ Extend university capabilities in space
 - ❑ Gather data about the moon
 - ❑ Outreach tool
 - ❑ PR opportunity for Stanford
 - ❑ Increase public interest in space
 - ❑ Competition
 - ❑ To have FUN!!
-

Lunar Mission

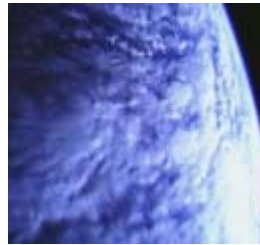
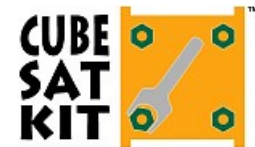
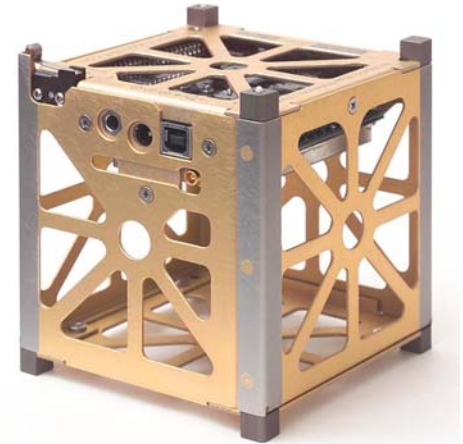
Lunar Mission

- 6 CubeSats
- Carrier
 - Hybrid Engine
- Launch Vehicle
 - $\Delta v \sim 7.7\text{km/s}$
- Swing-by Mission
 - $\Delta v \sim 3.1\text{km/s}$
- Cost
 - $\sim \$2$ million

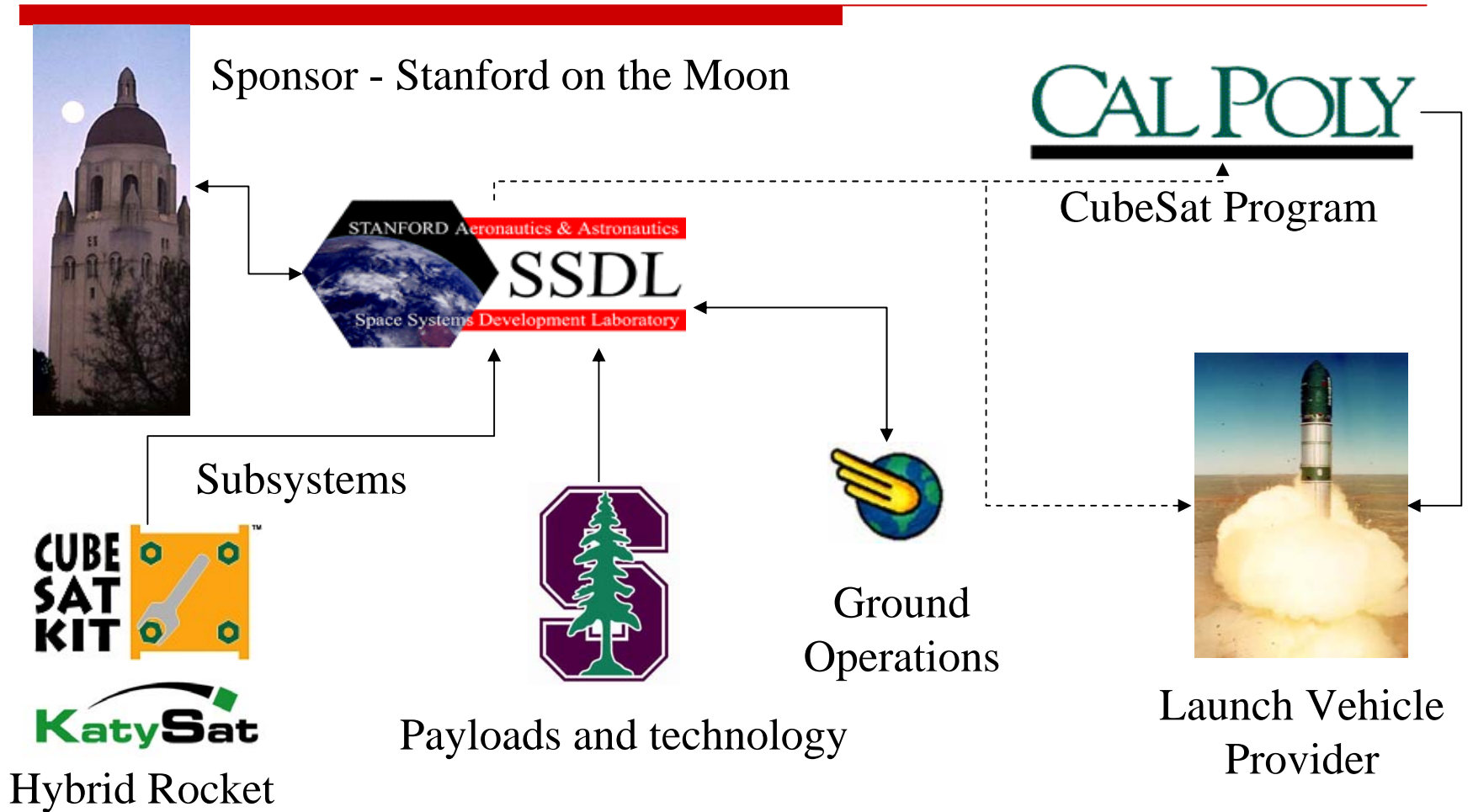


CubeSats

- ❑ Volume: 10 x 10 x 10 cm³
- ❑ Mass ~ 1 kg
- ❑ Power ~ 1 W
- ❑ CubeSat Kit
- ❑ Advantages:
 - Lost cost (KISS)
 - Fast turnaround
 - COTS
- ❑ Prevalence: 70 universities worldwide
 - Successes: ~10 launches



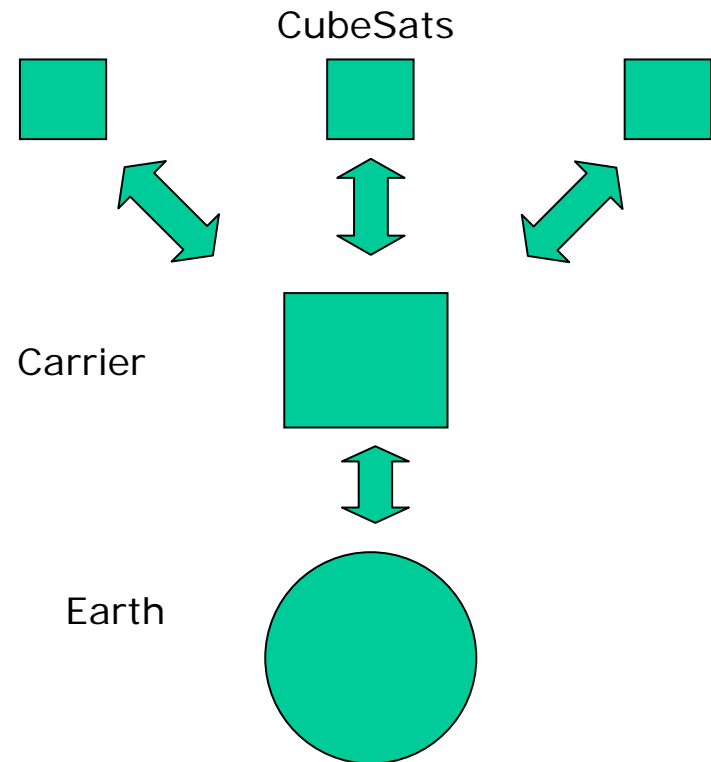
Mission Organization



Communication

□ Architecture

- Earth-Moon distance
~ 384,000km
- Carrier-Earth
 - High power, high gain carrier
 - Attitude control
- Local to Moon
 - Low power CubeSats and carrier



Communication

- Sat → Carrier → Ground
 - Routine reporting in cyclic order
 - Local IP networking
 - FIFO queuing of messages
 - Message flagging
 - Carrier onboard processing/direction
 - Ground station networks
 - Mercury network
 - Purchase time
 - Memory issues
 - Orbit vs. quick flyby storage requirements
-

Summary

- ❑ Feasible lunar CubeSat mission
 - ❑ Preliminary mission design
 - ❑ Hierarchical communication network

 - ❑ *Let's get to work!*
-

Thank you!

Questions?

For more info

<http://ssdl.stanford.edu>

<http://www.stanford.edu/~kldavis/SLAM>