2016

Time Capsule to Mars (TC2M)

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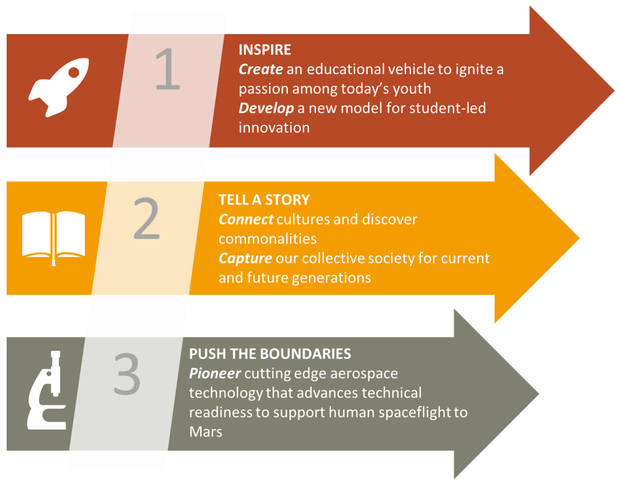
Problem Statement

TC2M is a nationwide, student-led mission tasked with the design, transport and landing of a time capsule on the surface of Mars. The Florida Institute of Technology team is tasked with conducting the systems engineering for the multi-university team, and to perform assembly, integration and test functions in the 2018 timeframe.



Mission Objectives

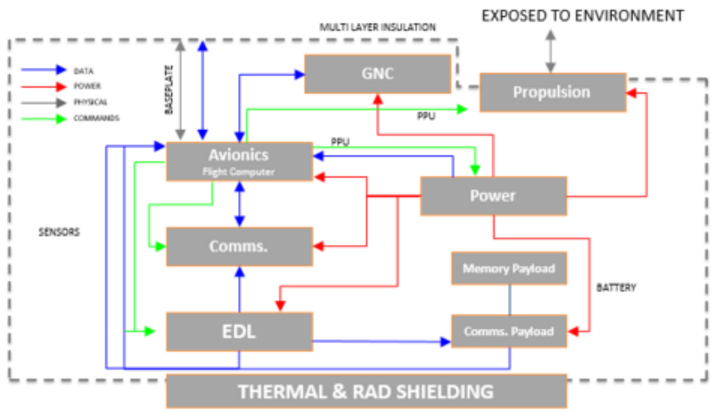
- Transport the time capsule to Mars via a cruise stage bus with its own propulsion system
- Land a data cache carrying pictures and expressions from the people of Earth safely on the surface of Mars
- Communicate back to Earth after landing, proving the time capsule arrived safely

Subsystems

TC2M TIME CAPSULE TO MARS

Systems Engineering

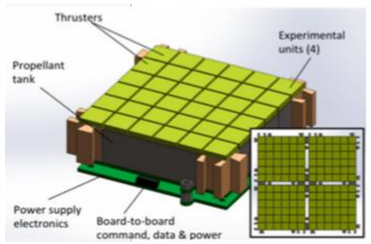
FIT was brought on the project in spring 2015 as the systems engineers and for assembly, test, and launch operations (ATLO). The first objective was to establish communication between all of the different subsystems. Each subsystem is assigned a point of contact from the team at FIT for a weekly meeting and status updates; then the point of contacts meet to ensure subsystem cohesion and system integration. The system interface diagram is shown below.



Once communication had been established, the next objective is the completion of the master systems requirements. These requirements, broken up by subsystem, provide the framework and technical specifications that guide the project as a whole. Several of the systems engineering deliverables are below:

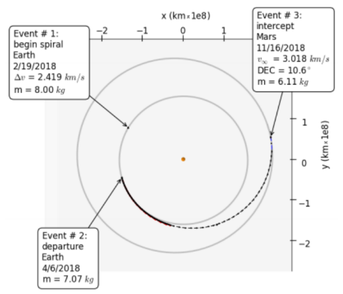
- Master System Requirements Document
- Conceptual System Models
- Concept of Operations
- Systems Interface Documents

Technical Approach



The ion Electrospray Propulsion System for CubeSats was designed by MIT with the following system parameters:

- Maximum Thrust: 3.3 mN
- Power Required: 58 W
- Specific Impulse: 2200 s
- Thruster Weight: 2.5 g
- Max Propellant Mass: 3.0 kg

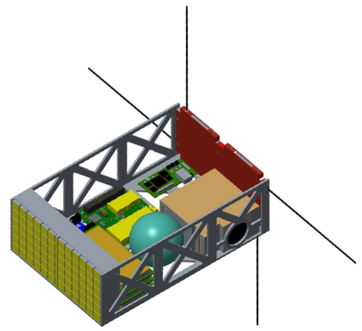


A possible interplanetary trajectory obtained by CU Boulder in a trade study through NASA Goddard's Evolutionary Mission Trajectory Generator. The nominal trajectory selected from the study has a flight of 270 days while consuming 1.9 kg of propellant.

System Models

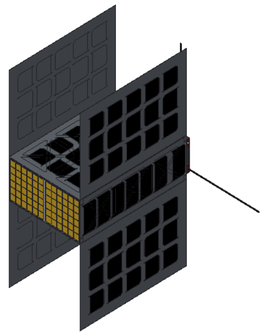
The team at FIT will use two system models to gain a better understanding of the actual project model. Conceptual models provide an accurate glimpse at volumetric representation, system integration, and component design.

System Integration Model



Shows the physical and electrical interfacing of the subsystems. The model provides a true volumetric budget for potential components; parts include the battery, payload, star tracker and propulsion tiles.

Solar Panel Model



Depicts a possible solar panel configuration for the cruise stage of the mission; the entire outer structure is covered in solar panels with exception of the propulsion tiles.

NORTHROP GRUMMAN

Engineering & Science Student Design Showcase at Florida Institute of Technology