DEEP SPACE MULTI-CUBESAT TELECOMMUNICATION

Rosario G. Diaz[1], Shuaike Chen[1], Mejéan Cline[1], and Humberto Molero[1]
[1]Department of Electrical and Computer Engineering
University of Houston
Houston, TX 77204-4005

Project Summary

With NASA's focus on Mars exploration, there have been concerns about the use of Cube Satellite, or CubeSat, technology. CubeSats are an inexpensive, lightweight, and powerful technology; however, they have never been used in deep space telecommunication and have a limited lifespan. Both, are problems hindering NASA's mission to further explore Mars using the CubeSat technology.

Our team is determined to improve the performance of the CubeSat's current systems by implementing a redundancy system that allows the satellite to power back on without external efforts as well as creating an inexpensive & self-sustaining telecommunication system to communicate from Mars (deep space) to Earth Mission Control. For the purposes of this project, a self-sustaining system will be defined as a system capable of identifying its power needs and running protocols to attain a minimum three-year lifespan. This telecommunication system will be modeled using three CubeSat systems: Alpha-Master, Beta-Master, and Beta, as well as one additional telecommunication system to function as mission control.

Due to constraints, our product will be a small-scale prototype meant to provide a foundation for future CubeSat applications. The prototype will provide system power and telecommunication standards and applications that can be translated to a full-scale product.

Problem and Need

Problem:
A sustainable CubeSat system to establish and maintain telecommunications from Mars to Earth does not currently exist.

Need:
An inexpensive and self-sustaining telecommunication system to communicate from Mars to Earth Mission Control during a Mars orbiting mission.

Significance

The self-sustaining CubeSat system will serve as a powerful and cheap alternative for Mars exploration and deep-space communication, and therefore has a direct relevance to NASA as well as to all other space agencies interested in deep space telecommunication network systems.

Goal

Design and establish a telecommunication system to communicate between CubeSats with redundancy protocols while attaining a three-year power lifespan.

Customer/User Analysis

Our CubeSat system is intended to be used and monitored by a team of engineers from either NASA or one of the contracted industry partners. These engineers will need to have expertise in satellite operations, control systems, deep space telecommunication, redundancy protocol, and power systems.

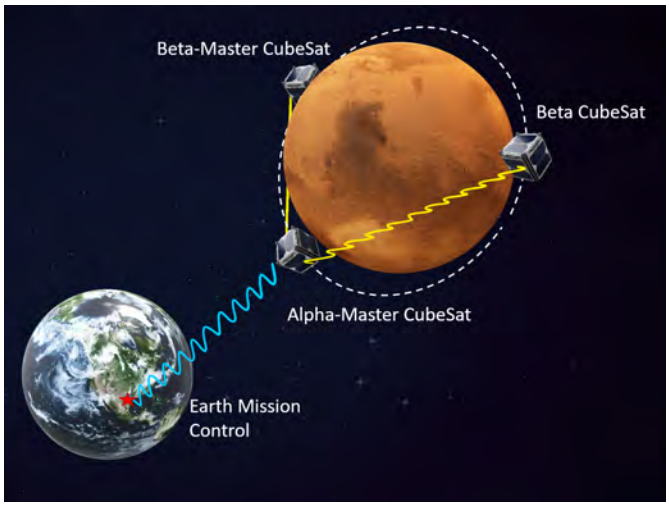
Deliverables

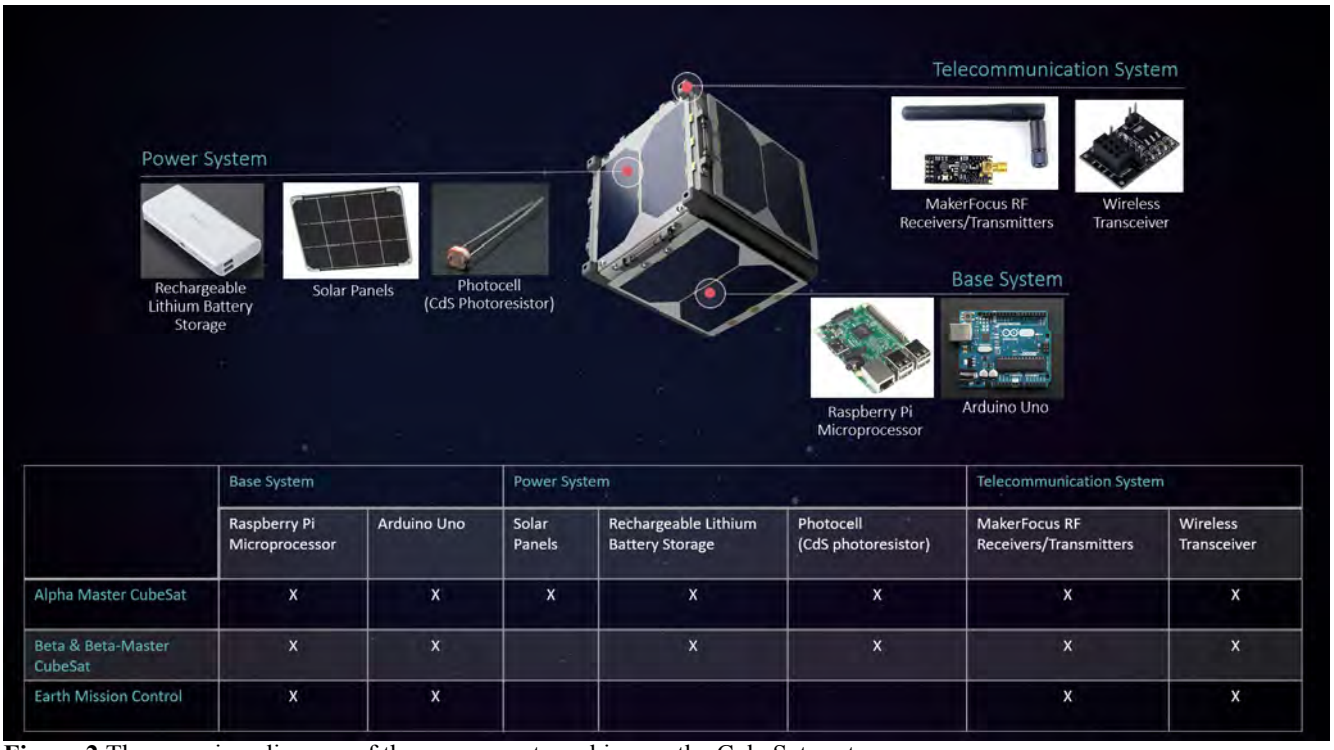
A CubeSat telecommunication and power system prototype comprising of four CubeSats: Alpha-Master, Beta-Master, Beta, and Earth Mission Control. This system will be self-sustaining, adhering to the three-year life span requirement, as well as have redundancy protocols to extend longevity of the system as a whole.

Terminal Objective

Design and establish a telecommunication system to communicate between CubeSats with redundancy protocols while attaining a three-year power lifespan.

Overview Diagram





	Base System		Power System			Telecommunication System	
	Raspberry Pi Microprocessor	Arduino Uno	Solar Panels	Rechargeable Lithium Battery Storage	Photocell (CdS photoresistor)	MakerFocus RF Receivers/Transmitters	Wireless Transceiver
Alpha Master CubeSat	X	X	X	X	X	X	X
Beta & Beta-Master CubeSat	X	X		X	X	X	X
Earth Mission Control	X	X				X	X

Figure 2 The overview diagram of the components making up the CubeSat system.