Design and Analysis of a Mars Supply Spacecraft
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Introduction
Space exploration is an important part of America’s technological development. This development, however, needs a goal and for many, this goal is to send human astronauts to Mars. Before undertaking this mission, a means to supply power and other necessities to the astronauts on Mars is required.

This poster considers one part of a space solar power-based mission to supply wireless power for use on the Martian surface. It presents a cargo capsule designed to house the necessities for human survival, as well as research equipment, and safely deliver them to a predetermined destination on Mars.

This landing capsule is also intended to house astronauts once they’ve landed. Providing them with a form of shelter to protect them for the dangers of the Martian Surface

Functions and Features
The supply capsule is designed to safely deliver supplies (food, tools, research equipment, etc.) to a pre-specified landing zone on the Surface of Mars. The Mars reference mission designs describe numerous considerations for mission location selection that would be relevant to this mission as well [2, 3]. Unlike conventional designs, this mission will use wireless power transfer to supply energy for use on the surface.

The Mars supply capsule utilizes three phases to deliver its cargo to Mars, in line with recommendations [2, 3]. First the capsule conducts a de-orbit burn and further slows down using the atmosphere of Mars. Once the capsule reaches a specific speed and altitude, a parachute deploys to further decrease the velocity of the capsule. Finally, rocket boosters are used to perform a soft landing ensuring research equipment and other fragile components and equipment are not damaged during the landing of the capsule.

Structural Design
In addition to its ability to make a controlled soft landing and protect the equipment housed inside, the capsule is also designed to function as a potential housing, research or storage facility. In other words, once landed, the capsule doesn’t go to waste and may act as an ‘extra room’ for astronauts to store excess supplies or to conduct experiments within. The capsule is compatible with numerous base design scenarios (including the 3D printing-based approach presented in [4]). The capsule is capable of maintaining pressurization for an extended duration of time.

The capsule will initially house rectenna antennas which can be deployed to receive the power transmitted from orbit (this is shown in Figure 3). It is likely that these will be deployed a distance from the base (and capsule, if it is being used for living quarters or other human-occupied uses to protect the astronauts from radiation exposure.

Landing Safety
Because Mars has a density less than 1/100th that of the Earth’s, during entry the capsule will experience significantly less drag resulting in a higher velocity during entry. To resolve this, this capsule is equipped with four rocket boosters which will allow the supply capsule to counteract its entry velocity and maneuver in order to safely land on the surface of Mars.

Conclusions & Future Work
This poster has described the initial design for a supply capsule that could be used for a potential mission to Mars. This capsule is capable of making a controlled landing and is purposed to deliver and (based on mission needs) store necessities to support astronaut activities on the Martian surface. For versatility, this capsule can be used as laboratory, storage or housing space once landed on Mars.

References