

CubeSats-to-Mars Program

A private, not-for-profit Mars Mission Concept developed by a group of entrepreneurial organizations



Private Mars Missions?

Is it Possible? Many converging concepts imply yes

- There is great interest by individuals and private organizations to support space exploration
- Interest by countries with limited space exploration resources
- Companies are more capable and are interested in funding valuable planetary science missions
- Interest in access to space from Universities and students

The environment is right for a private (or public/private) effort

- Strong International interest in planetary science and human missions to Mars
- NASA's significant budgetary cuts in space science have slowed Mars missions
- Small key robotics mission prior to sending a crew can create international interest and provide valuable data

Private Mars Missions? Opportunity

Unprecedented opportunity for students to design hardware to send to another planet

- Large number of modestly priced CubeSats allows CubeSat developers to train, inspire, and challenge students
- A national or international student competition could be held seeking innovative designs of a CubeSats for use at Mars

Opportunity to make significant contributions to our understanding of Mars

Opportunity for small countries to mount their own Mars mission
- a paradigm shift

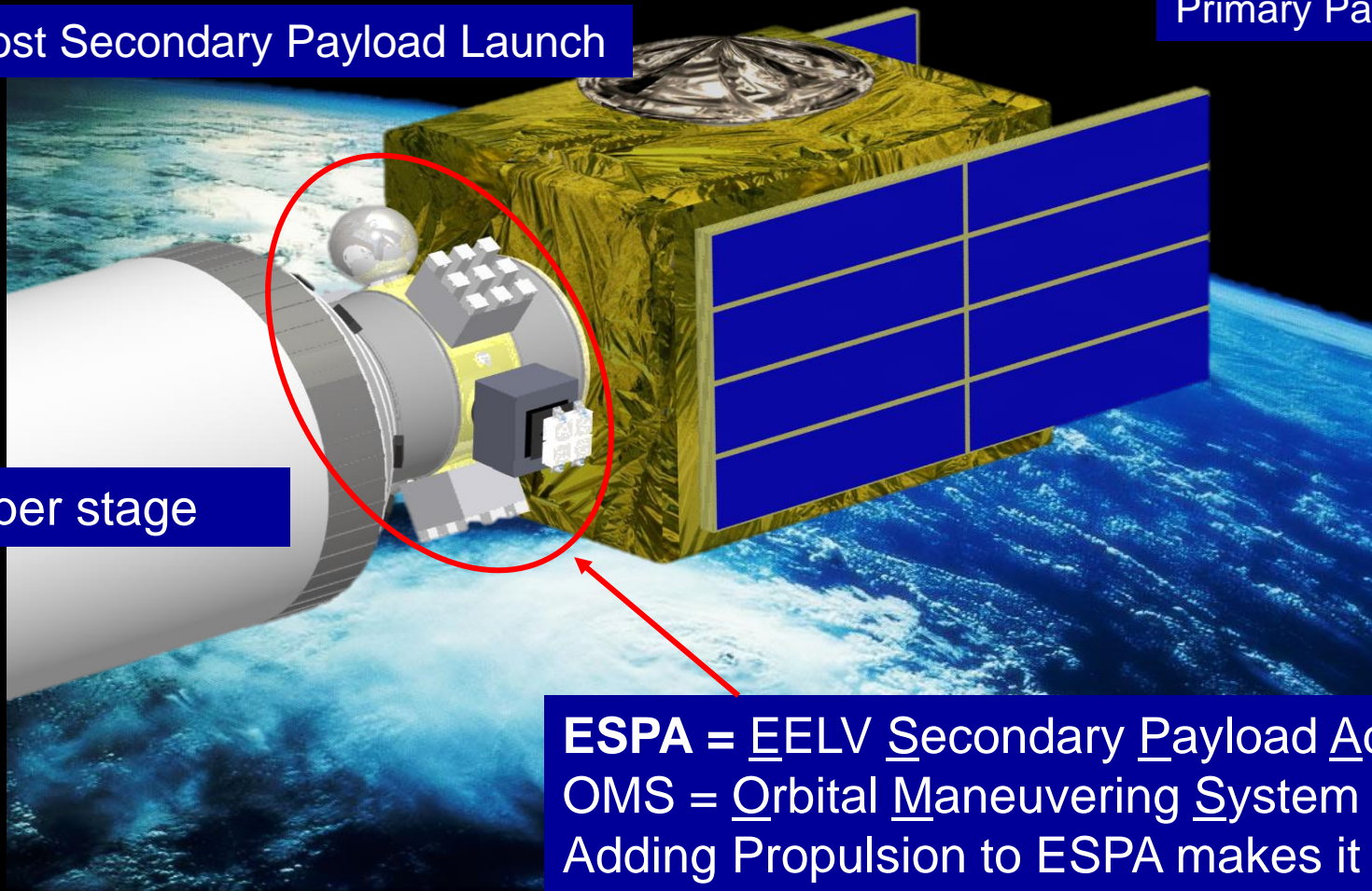
Missions based on passion for exploration, understanding Mars, and advancing SOA space technology could make private sector Mars missions a reality by the middle of this decade

CubeSats to Mars carried by ESPA-OMS Carrier

Primary Payload

Low Cost Secondary Payload Launch

upper stage



ESPA = EELV Secondary Payload Adaptor
OMS = Orbital Maneuvering System
Adding Propulsion to ESPA makes it OMS

Mission Concept

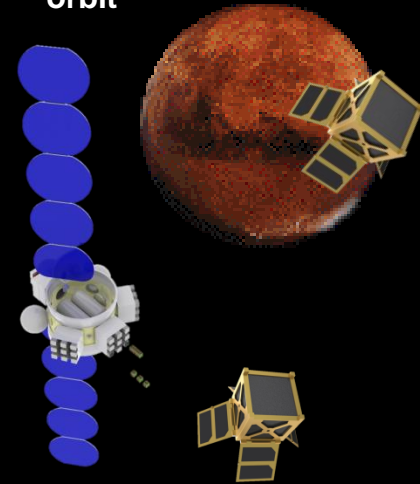
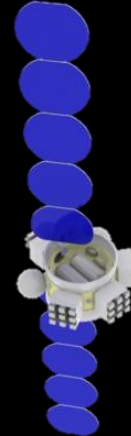
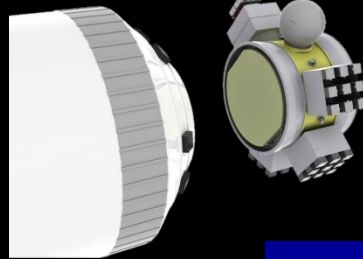
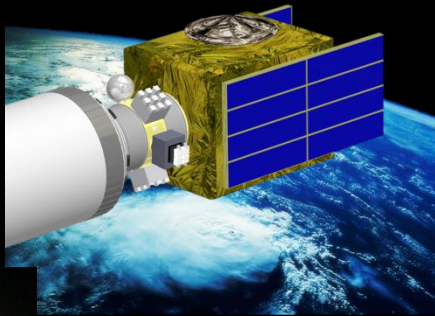
CubeSats are deployed after entering Mars orbit

Solar panels are deployed and carrier begins the journey to Mars

After primary payload release the CubeSat carrier released from the second stage

as secondary payload with GEO primary payload

Carrier for CubeSats launched



The CubeSats are carried to Mars by ESPA OMS. ESPA is EELV Secondary Payload Adaptor ring with propulsion making it OMS – Orbital Maneuvering System.

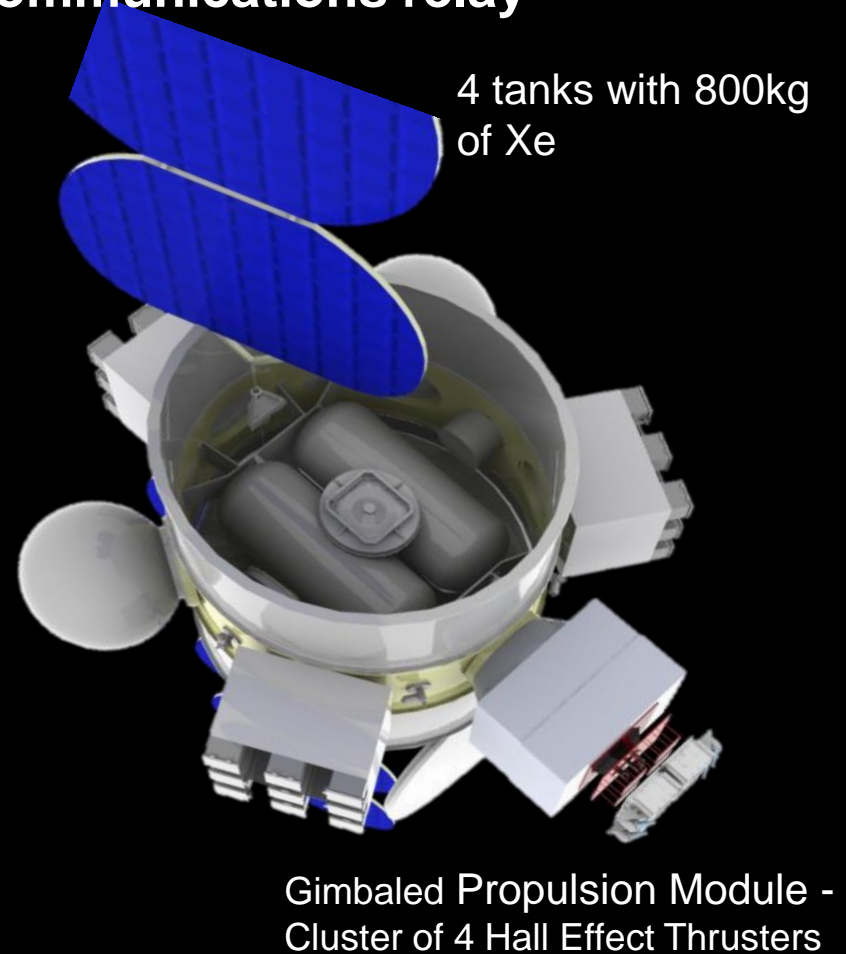
The CubeSat carrier or ESPA OMS using high efficiency propulsion can carry up to 27 – 3U CubeSats to Mars.

ESPA OMS Carrier

delivers ~27 of 3U Cubesats to Mars
and then serves as a communications relay



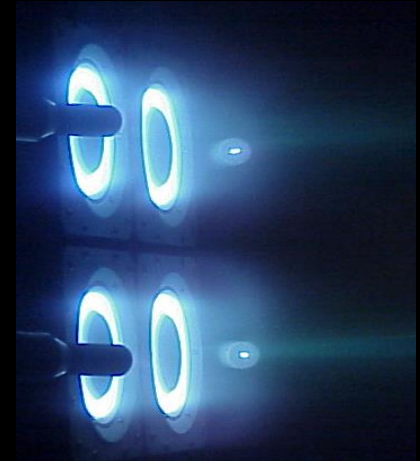
27 P-Pods positions
Each can house up to
5U CubeSat



Stimulating broad international participation, nations fly their own Cubesats to Mars

Readiness and Mission Analysis Conclusions

- Technology is sufficiently developed for margins in all areas of performance
- The ESPA OMS equipped with ion type Hall thrusters and 4kW solar array makes low cost pre-cursor missions to Mars (or Phobos) possible
- ESPA OMS remains to relay data to/from Earth
- Nominal launch date of 28 November 2014, 20 January 2017 next window



Cluster of Hall Thrusters in operation

The CubeSats-to-Mars concept provides

- a robust,
- lower cost,
- and highly viable option

to mount the first private or semi-private mission to Mars.

Exploration Opportunities

- Once in Martian orbit, CubeSats would be released providing many appealing exploration opportunities
- Multiple small Mars orbiters allow the creation of a constellation of interconnected orbiters
 - For Mars science
 - Simultaneous atmospheric and weather observation
 - Increased communications and GPS-like navigation
- The ESPA-OMS serves as a lower cost communications relay for CubeSats and ongoing missions

Summary

- The CubeSats-to-Mars concept provides a robust, low cost, and highly viable option to mount the first private or semi-private mission to Mars. Estimated Cost <\$150M
- There are innumerable smaller, precursor missions that can be accomplished via this low cost ESPA OMS approach
- Private CubeSats to Mars missions can support future government missions with crucial data and infrastructure

We invite the participation of:

- Private individuals
- Businesses
- Universities and
- Governments worldwide

Interested parties should inquire by email to info@cubesatstomars.com