Why Phobos?

*Phobos and Deimos provide the perfect platform to address both scientific and human objectives for exploration*

- As a Precursor Mission:
  - Collect critical data in preparation for potential human exploration, retiring risk, reducing cost, and optimizing performance

- As a Science Mission:
  - Resolve the origins of the moons, including their relevance as potential targets of astrobiological potential
Phobos Surveyor: An Innovative Approach

Phobos Surveyor Mission concept provides an innovative low cost, highly reliable approach to exploring the inner solar system

- Dual manifest launch
- Use only flight proven, well characterize commercial off-the-shelf components
- Flexible mission architecture allows for a slew of unique measurements
SEP; Surveyor’s Backbone

Commerciially available Solar Electric Propulsion Hall Thrusters enable cost effective, flexible access to Mars

- Hall Thrusters are used extensively and reliably used by Int’l and US Communication Satellites
  - ≈ 200 satellites using this technology today
  - High heritage systems reduce cost and complexity
  - Current commercial systems are capable of handling interplanetary travel

- Commercial Hall Systems provide the perfect balance between high Isp, high thrust and low power
The Phobos Surveyor Spacecraft is more than capable of addressing important Human Exploration and Decadal Science Questions

- **Spacecraft Characteristics:**
  - Launch mass of ~400 kg/spacecraft (1000 kg total with ESPA Grande launch adapter)
  - 40 kg payload capability
  - Xenon propellant (no hazardous processing required)
  - ~4.5 km/s of delta-V
  - Up to 450 kbps communication via X-band based on Mars distance
  - 4 kW of power provided by two 8.2 m² Ultraflex solar arrays
Increasing Potential Launch Opportunities

The innovative launch approach of Phobos Surveyor not only lowers cost for planetary missions, but enables more opportunities for focused exploration.

- Phobos Surveyor utilizes three types of launches for rideshare opportunities:
  - Mars direct transfers
  - Lunar / Low energy launches
  - Geosynchronous launches

- Lunar and GEO launches would leverage lunar flybys to depart for Mars
Flexible Science Operations

The SEP architecture enable unique operations about Phobos to maximize decadal and precursor scientific return

- Phobos’s shape and gravity enable a variety of potential orbits based on requirements
  - ‘Distant Retrograde Orbit’ provides a stable orbit for imaging
  - ‘Multiple Polar Flyby Orbit’ provides low altitude opportunities to image the poles
  - Several other potential orbits exist
Potential Landed Exploration

Phobos Surveyor benefits from Phobos’s low gravity to safely access the surface of the body.

- A 3 m deployable boom allows the orbiter to contact the surface without risking major subsystem components
  - Xenon cold gas system is used to negate the low surface gravity of Phobos
  - Reaction wheels are used to ‘balance’ the spacecraft atop the boom
  - A small surface package located at the end of the boom conducts surface science
  - Communication is conducted by ‘tilting’ the spacecraft atop the boom

- Cold gas system could be used to hop to multiple locations
Conclusion

Phobos Surveyor offers a unique, innovative and lower cost approach to addressing important Human Exploration and Decadal Science objectives using multiple low cost, highly reliable SEP spacecraft.
Questions?