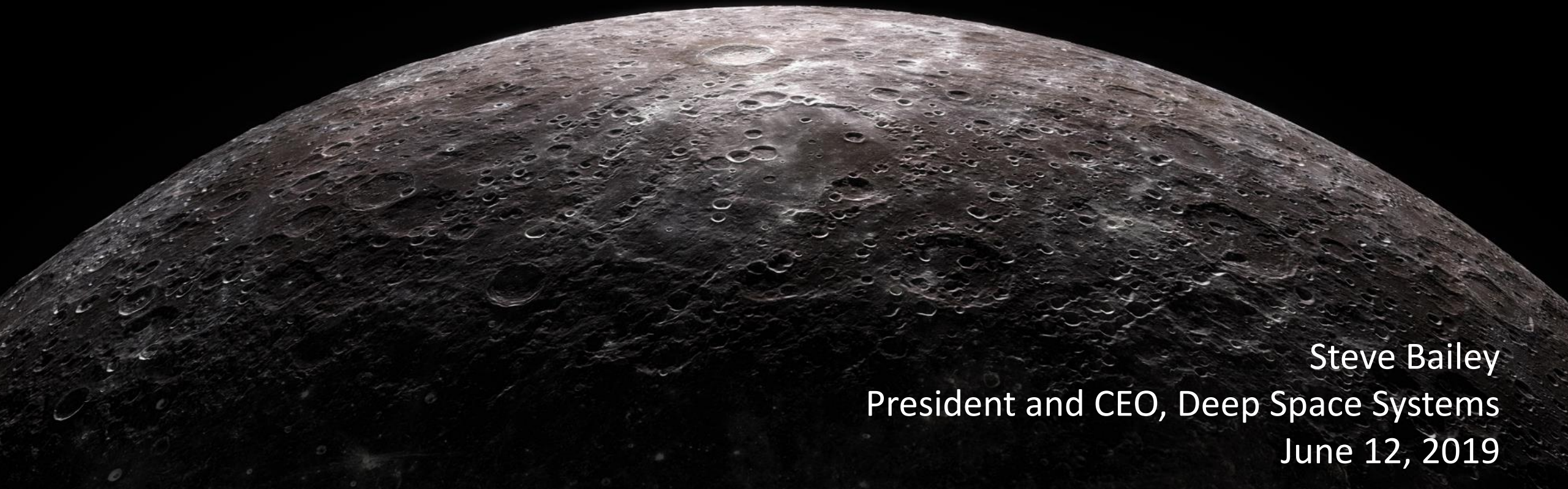


Commercial Lunar Payload Services Overview

Space Resources Roundtable and Planetary and Terrestrial
Mining Sciences Symposium, Colorado School of Mines



Steve Bailey
President and CEO, Deep Space Systems
June 12, 2019

DSS Founder, President and CEO



Steve Bailey

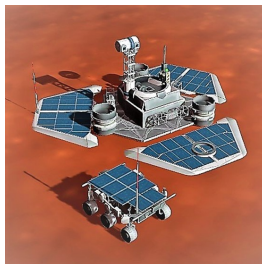
- Founded Deep Space Systems in 2001
- Guided company from 1 person to 65 employees
- Expanded to include spacecraft flight hardware in 2016



→
MARS



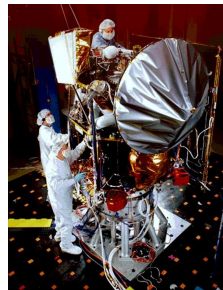
→
MOON



1996
Mars Pathfinder
Jet Propulsion Lab



1998
Lander Design Lead
Mars Polar Lander



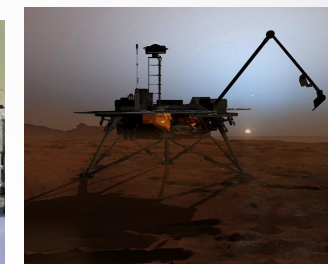
1998
Mars Polar Lander



2001
Mars Odyssey

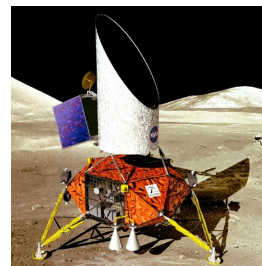


2005
Orbiter Design Lead
MRO



2008
Mars Phoenix

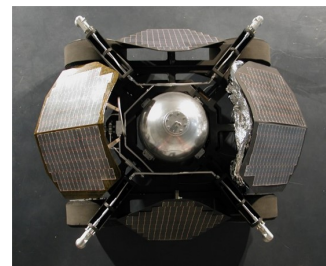
←
**MARS
Missions**



1991
Program Manager JSC
Artemis Lunar Lander



1994
Clementine II
Jet Propulsion Lab



1999
Lander Design Lead
Blastoff! (Idealab)



2003 / 2005
Lander Design Lead
MoonRise (New Frontiers)



2004
Lander Design Lead
Copernicus (Discovery)



2013
Lander Design Lead
Moon Express



←
**MOON
Missions**

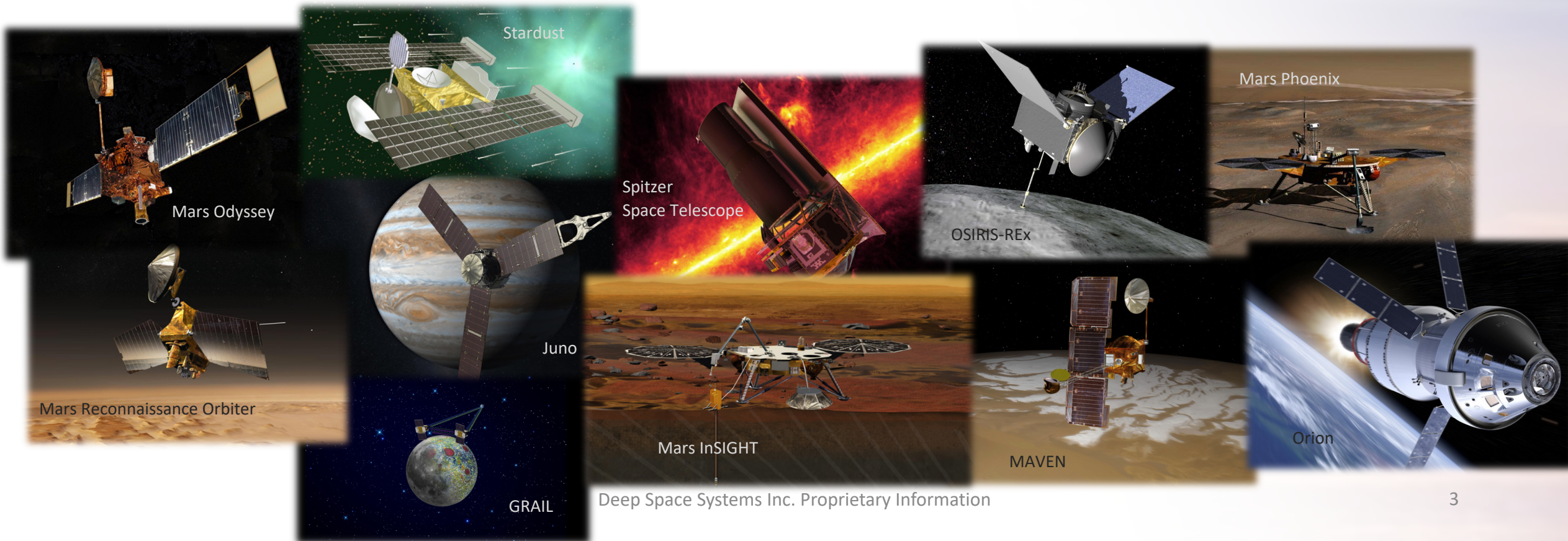
DSS Engineering Bench Strength

15 DSS space system contracts (including all the missions illustrated below)

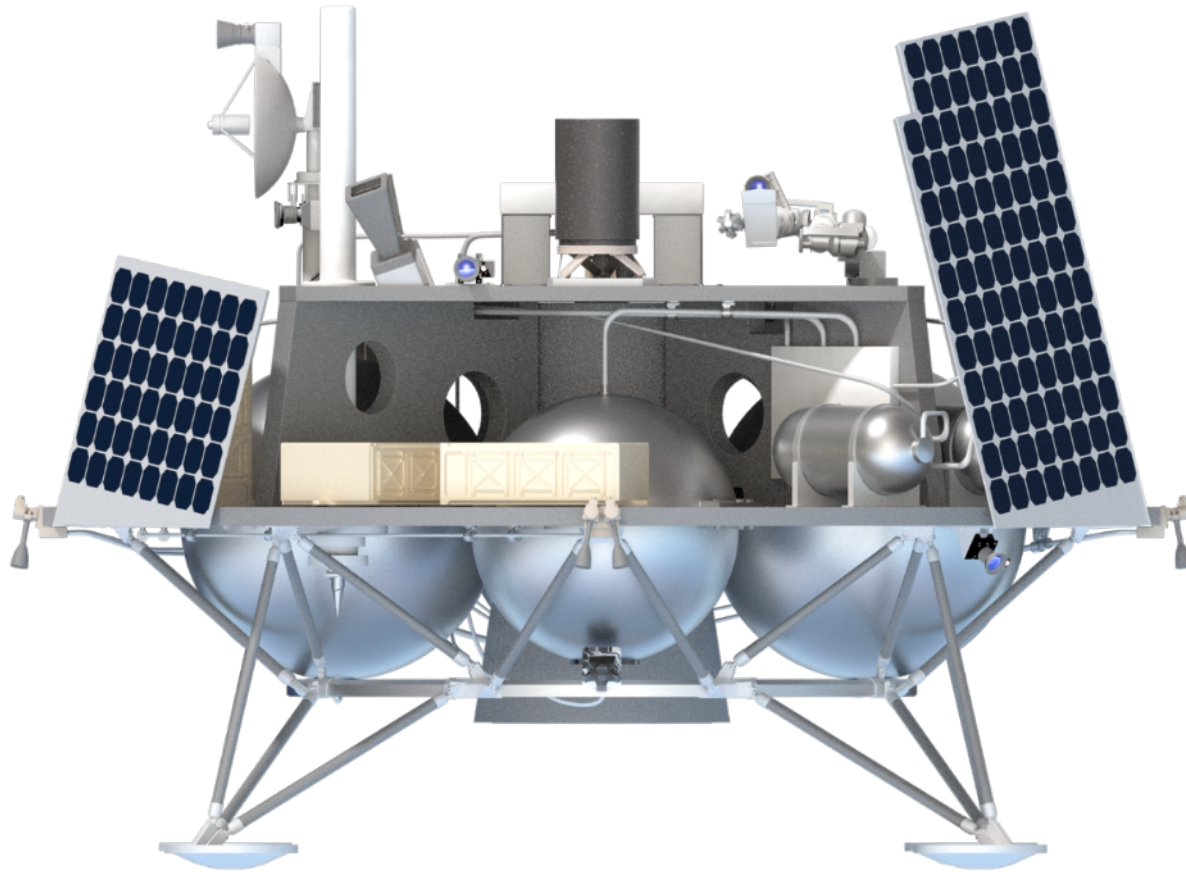
DSS Team Members have worked on 25+ other space flight programs

Experience on human, robotic, government and commercial programs

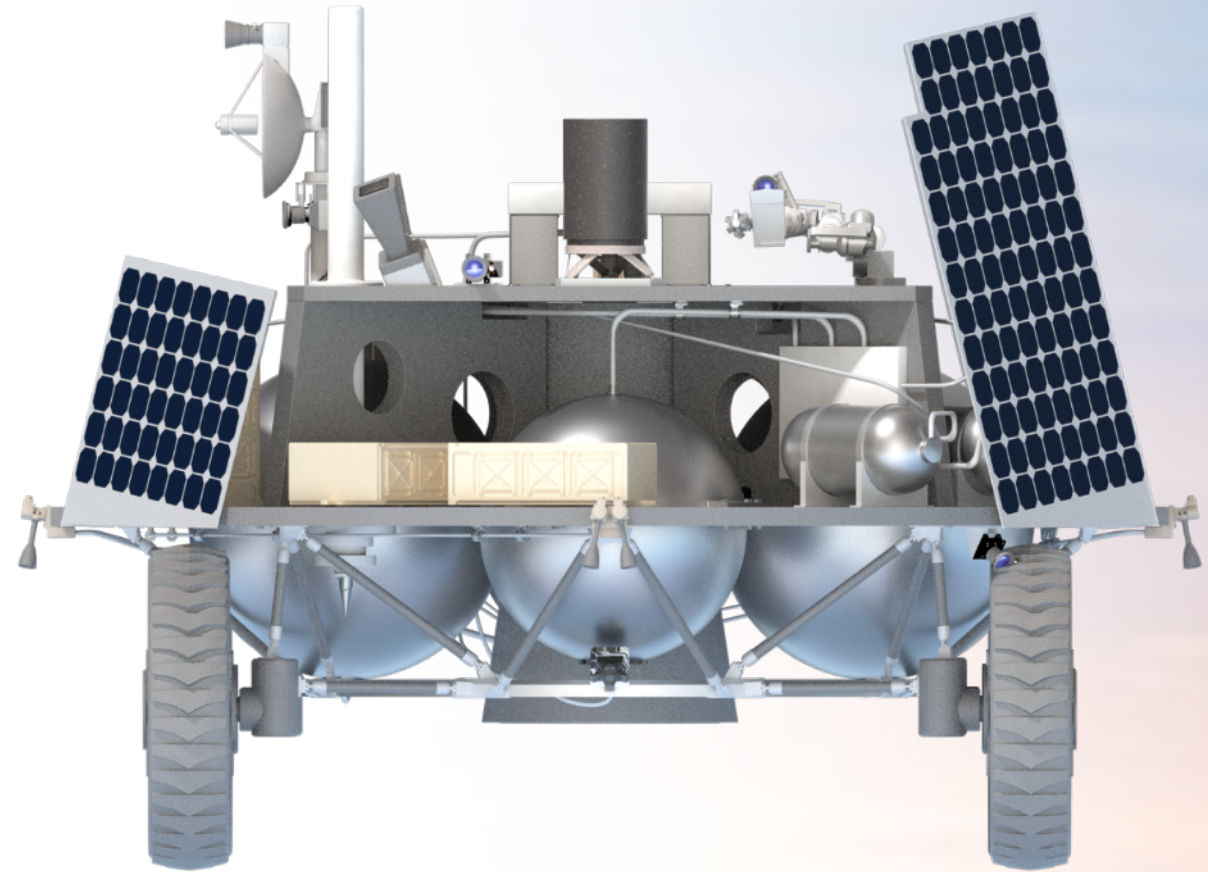
+700 years of spacecraft formulation, development, build, test and operations



The DSS Accommodates Cubesat Deployment from High and Low Orbit and Features a Rotary Percussive Drill and Sample Acquisition System as Standard Equipment



Fixed Base Lander



With Mobility System

DSS Midsize Lander

Payload Summary

Mass: up to 100 kg

Volume: 3.36 m³

Power: 400 W (all mission phases)

Comm: 1-10 Mbps downlink

Destination: High Latitude Sites

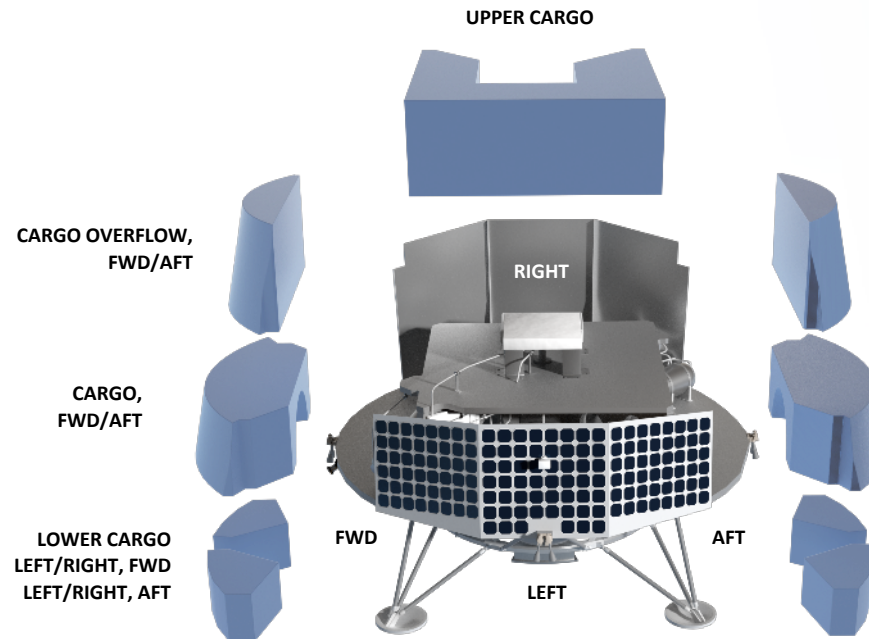
Landing: DSS Midsize Lander

Payload Volumes

- Upper Cargo: 0.9 m³
- 2X Cargo Overflow: 0.26 m³
- 2X Cargo: 0.85 m³
- 4X Lower Cargo: 0.06 m³

Standard Payload Features:

- Multiple Data Interfaces
 - < 1 Mbps: UART serial over RS-422, RS-485, LVDS
 - >= 1 Mbps: 10/100/1000 Ethernet, SPI over LVDS
 - Available: SPI, I2C, USB, Spacewire, MIPI CSI, Quad-SPI, I2S, 1553, Wi-Fi, CAN, low-voltage discretes, high-voltage discretes, and RS-422 differential discretes, heater control
- Multiple Power Interfaces:
 - Preferred: 28V
 - Available: 12V, 5V, or selectable voltage above/below 28V
- Data Storage: 1000 GB (1 TB)
- Payload Survival Heaters (two wire system)
- HiRes Camera Package (6 VisCams)
- Orbital/Surface Cubesat Deployment (1U up to 27U)



Special Lunar Science Features:

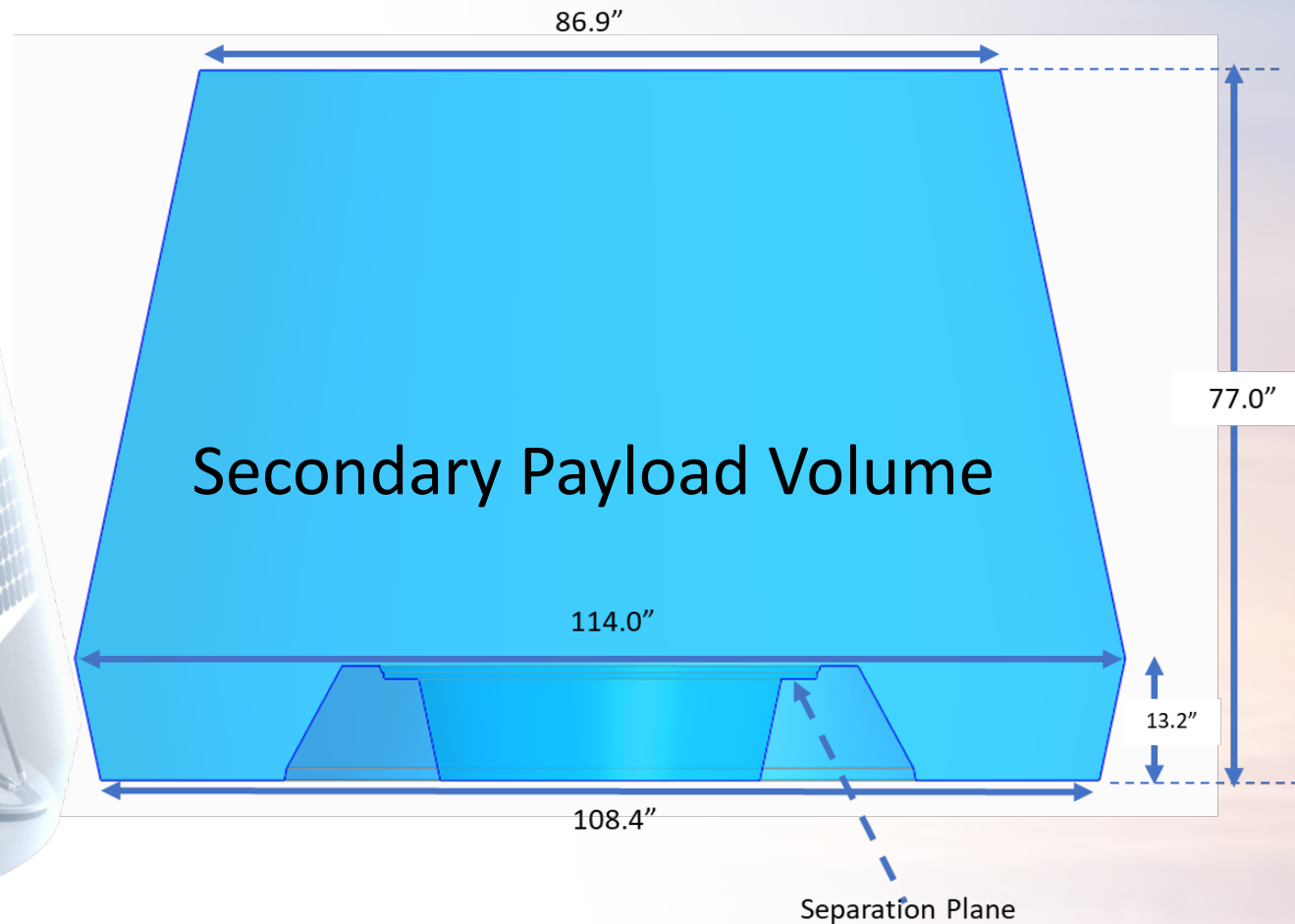
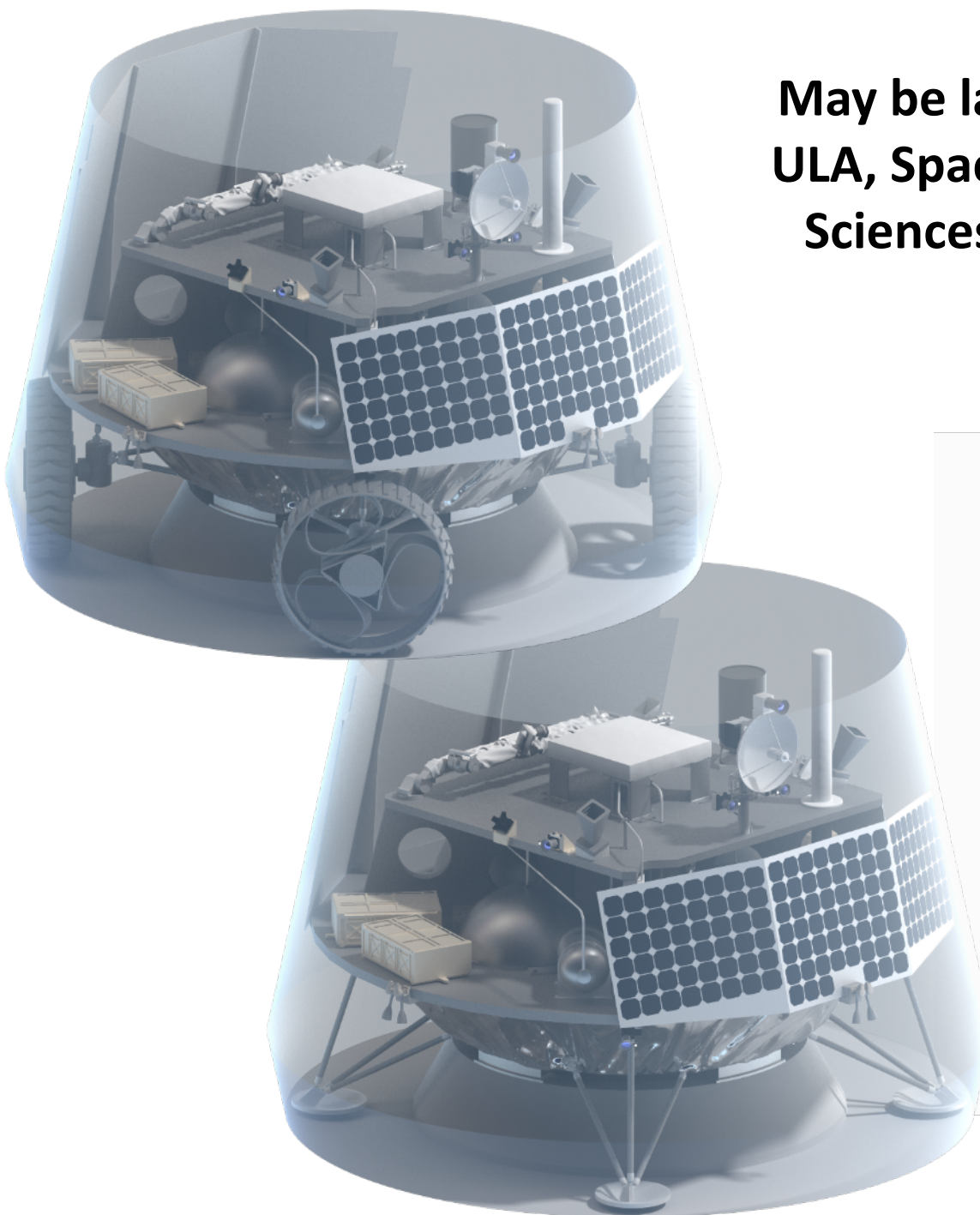
- Surface Roving Operations (up to 3 km/hr)
- 1 m Rotary Percussive Drill
 - Sample Delivery to Payloads
- Propulsive Hop Mobility (up to 4 km)
- Lunar Night Survivability
- Easy Access to Surface

More Options and Services:

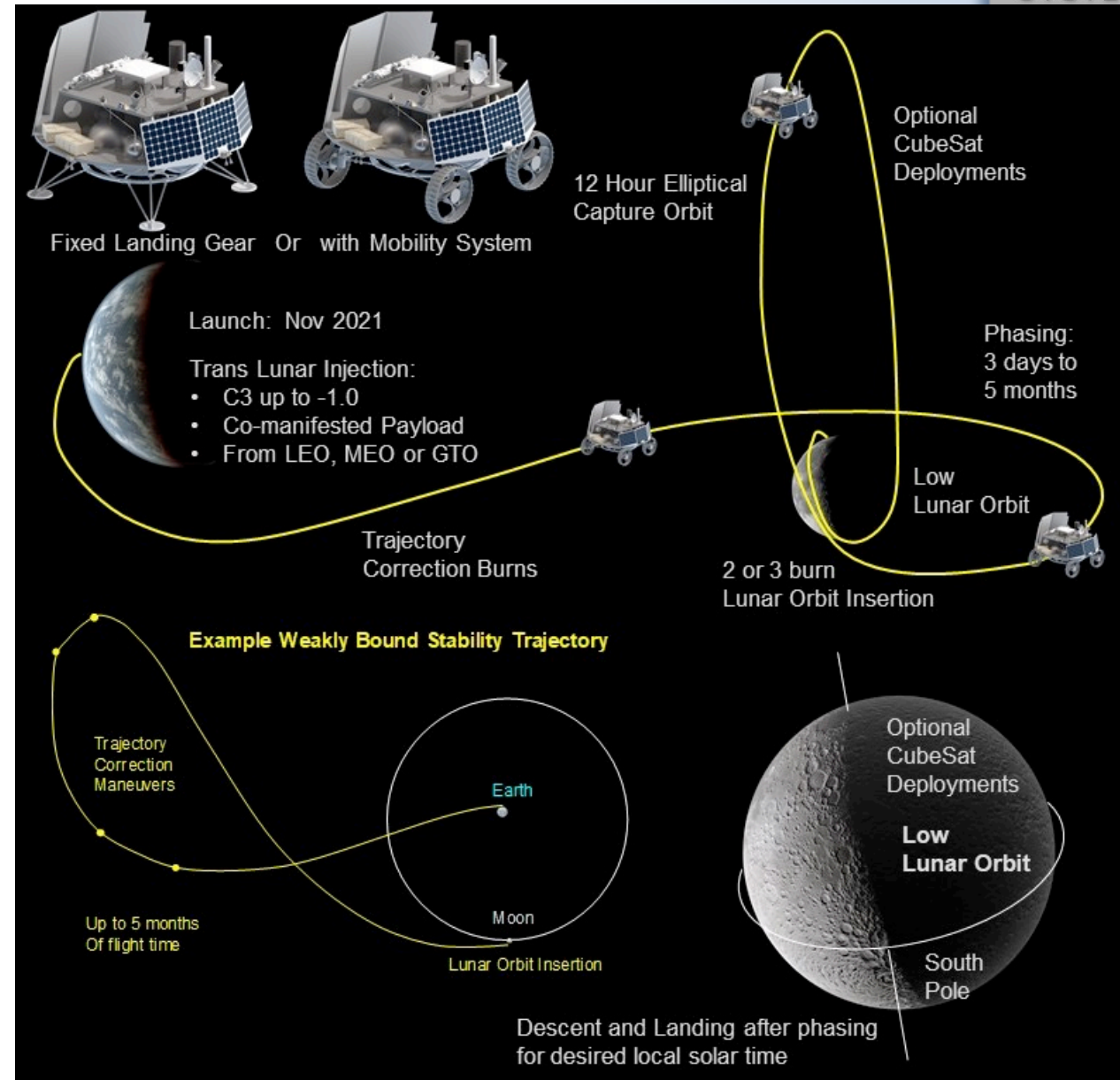
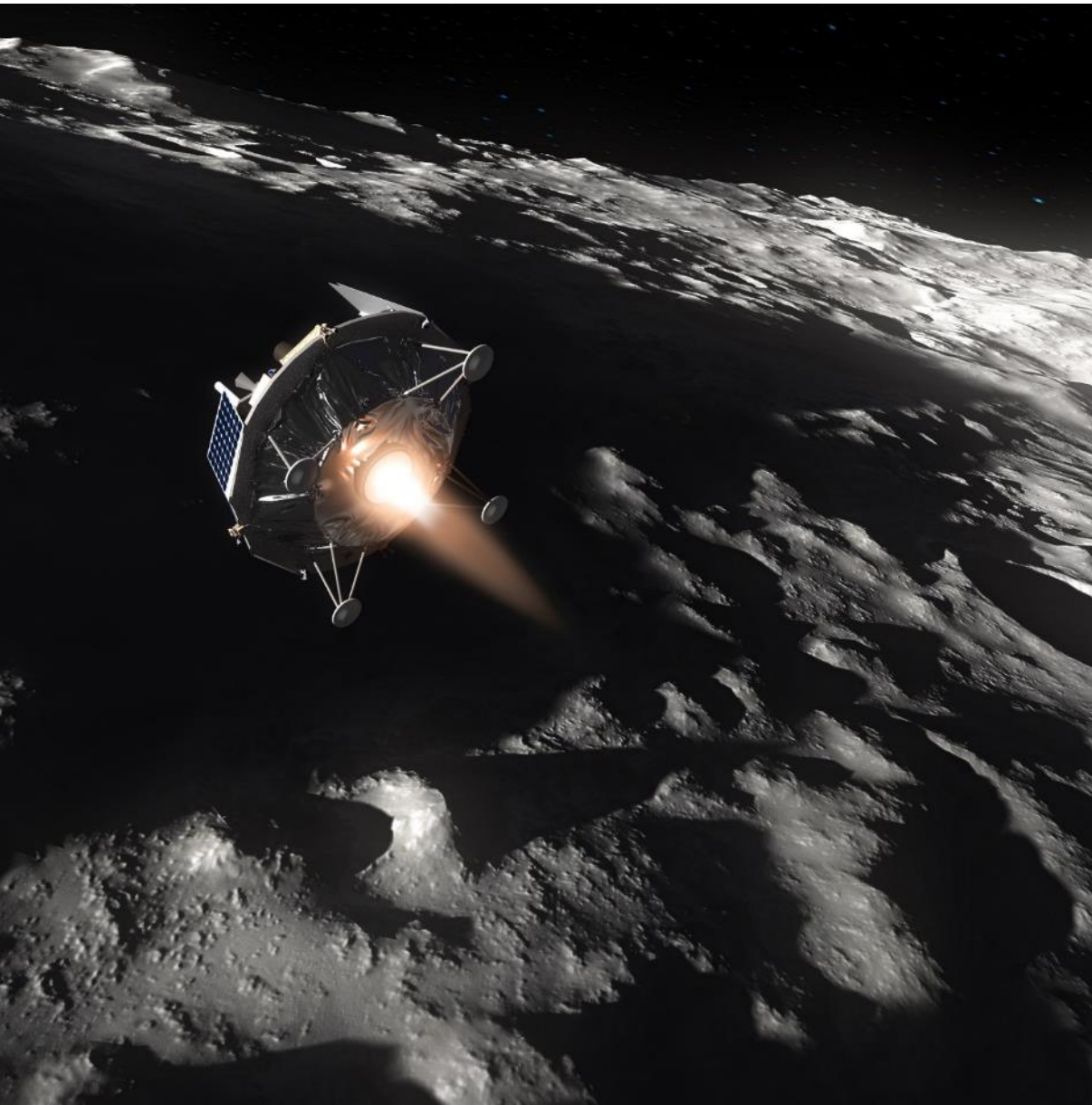
- 6 DOF Robotic Arm and Appendages
- Mast Mounted Payloads
- Auxiliary Solar Panels
- High Capacity Battery (60 Ahr)
- Up to 6 TB of Data Storage
- UHF Data Relay to Orbit (>128 Kbps 2 way)
- Payload Dedicated i5 Computer
- WiFi and/or WiGig Surface Radio Systems
- Custom Camera System
- Complete Payload Design, Development, Test and Integration Service
- Surface Cubesat Deployment (1U to 16U)

May be launched as a secondary payload on
ULA, SpaceX, Blue Origin, Arianne, or Orbital
Sciences Launch Vehicle from LEO or GTO.

Primary Payload

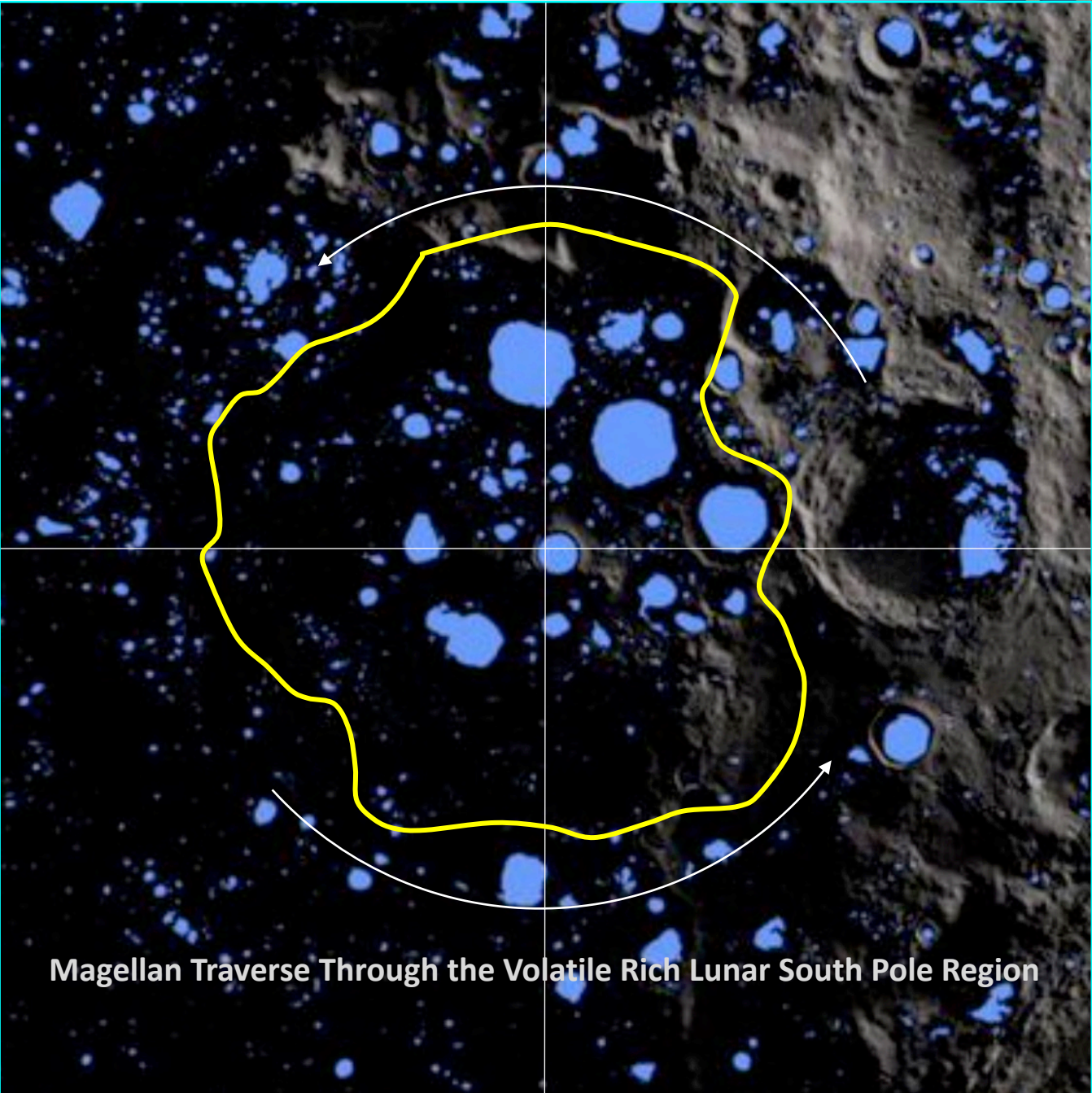
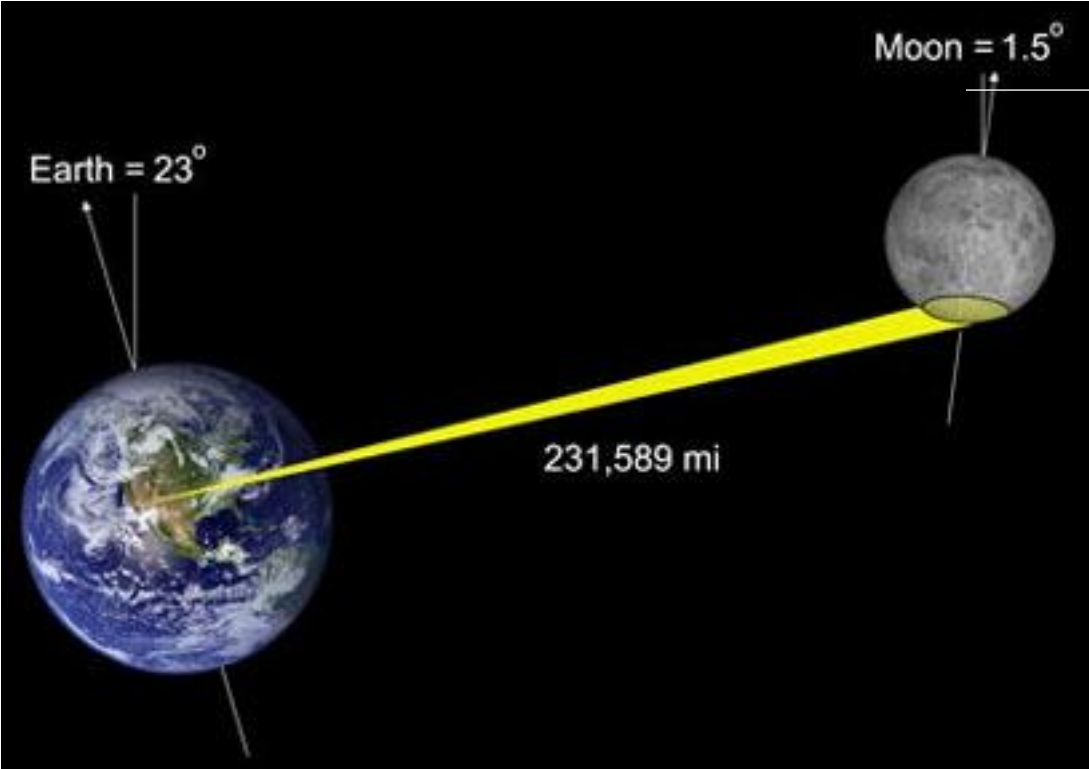


Deep Space Systems Awarded NASA Commercial Lunar Payload Services (CLPS) Contract Nov 29, 2018



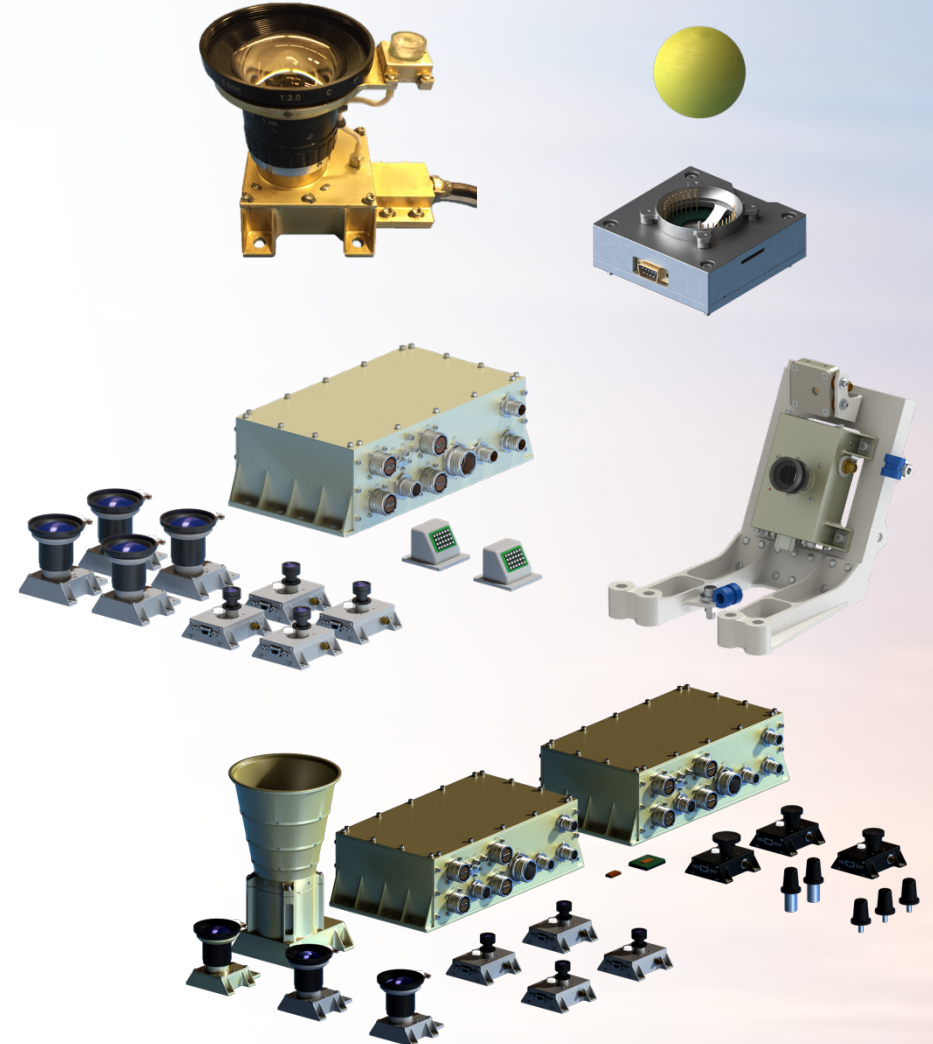
We plan to move and drill, move and drill, move and drill, always seeking the most abundant, pure, accessible and favorably situated sources of water ice.

The Mobility System allows us to circumnavigate the volatile rich polar region, racing, at 1 km/hr, to stay ahead of sunset.

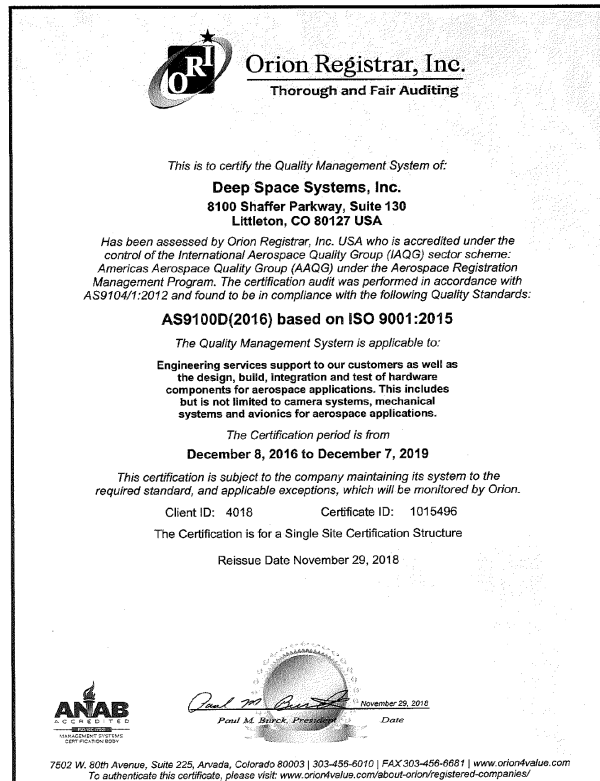


DSS Space Hardware

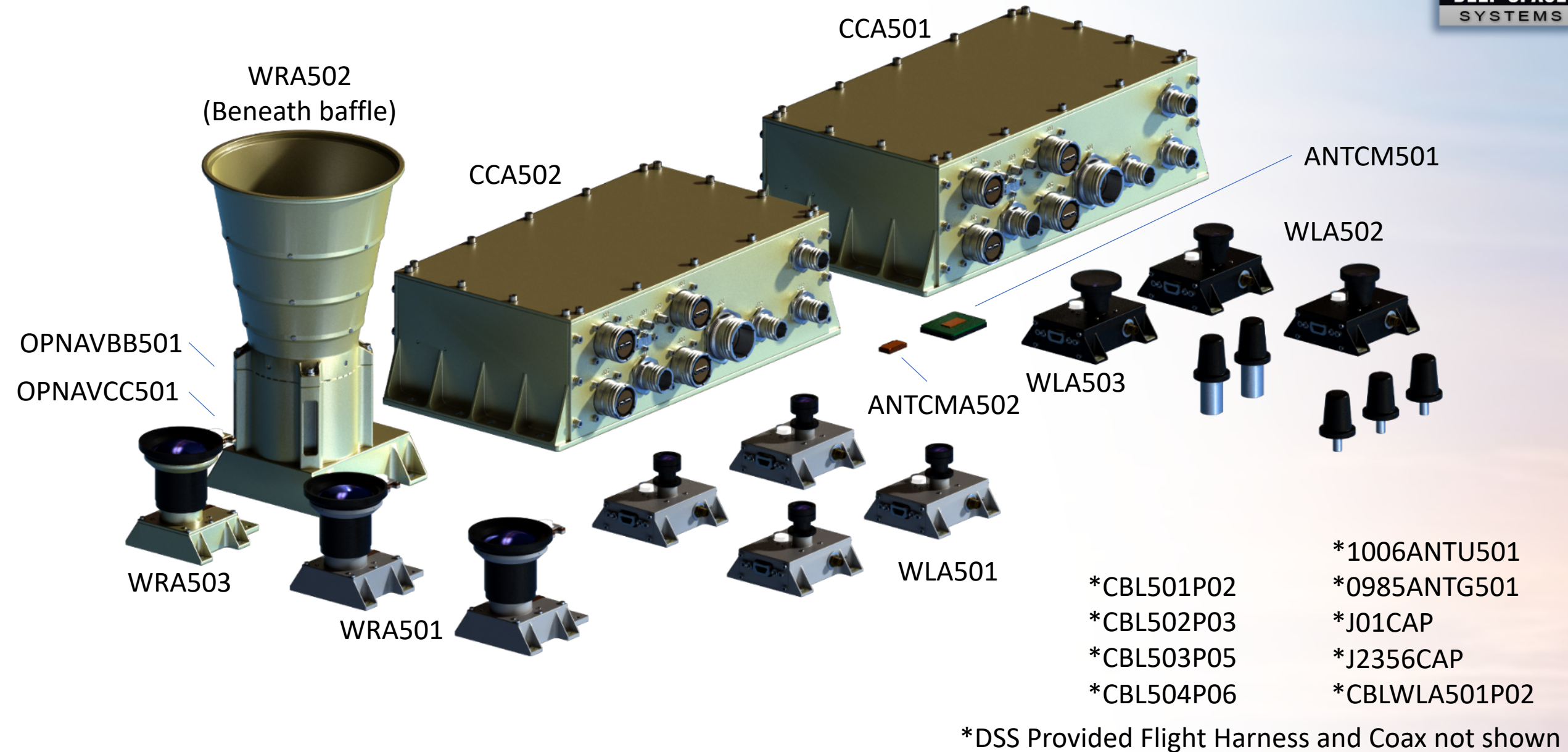
- Space-Hardened Cameras
- Spacecraft Avionics
- Data Acquisition and Recovery Systems
- Flight Computers
- Class D/Crit 3 to Crit-1S (Human Space Flight Rating)



DSS Quality Management Systems are certified to AS9100-D standards



Orion Camera System



Jasper Camera System Shipset



02-01-CAM-00-502



02-01-CAM-00-501



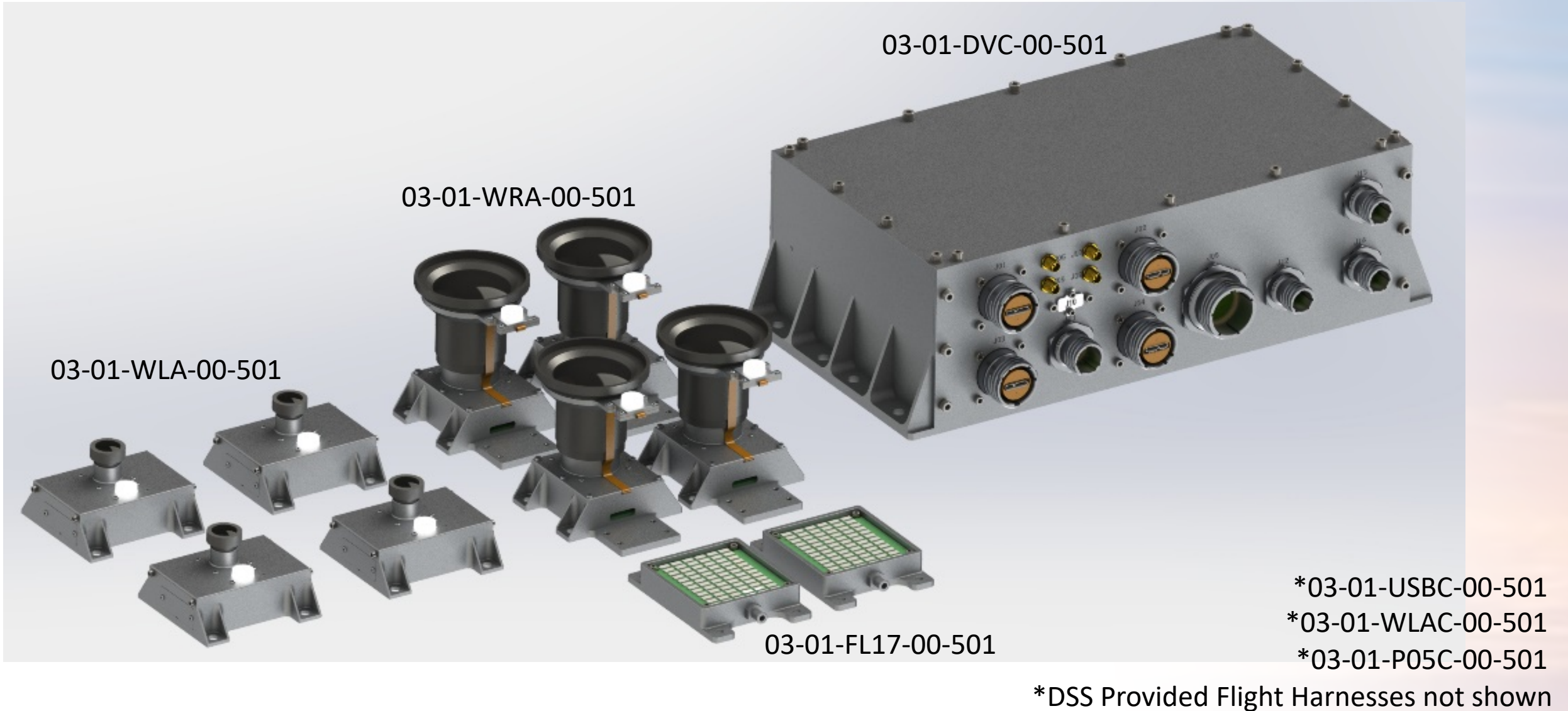
02-01-CB-00-501

*02-01-CBL-00-501

*02-01-CBL-00-502

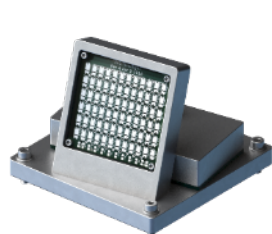
*DSS Provided Flight Harnesses not shown

Dream Chaser Video/Camera System Shipset

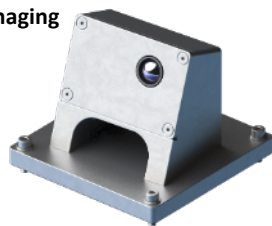


DARS – Data Acquisition and Recovery System

DSS MicroCapsule – Potential Applications

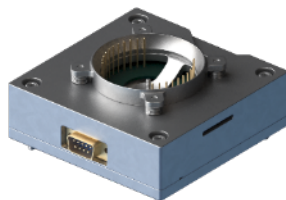


DARS Visible Imaging Video Camera
AKA VisCams



DARS Visible Imaging LED Flood Light
AKA Floodlights

Data Return Capsule (DRC)

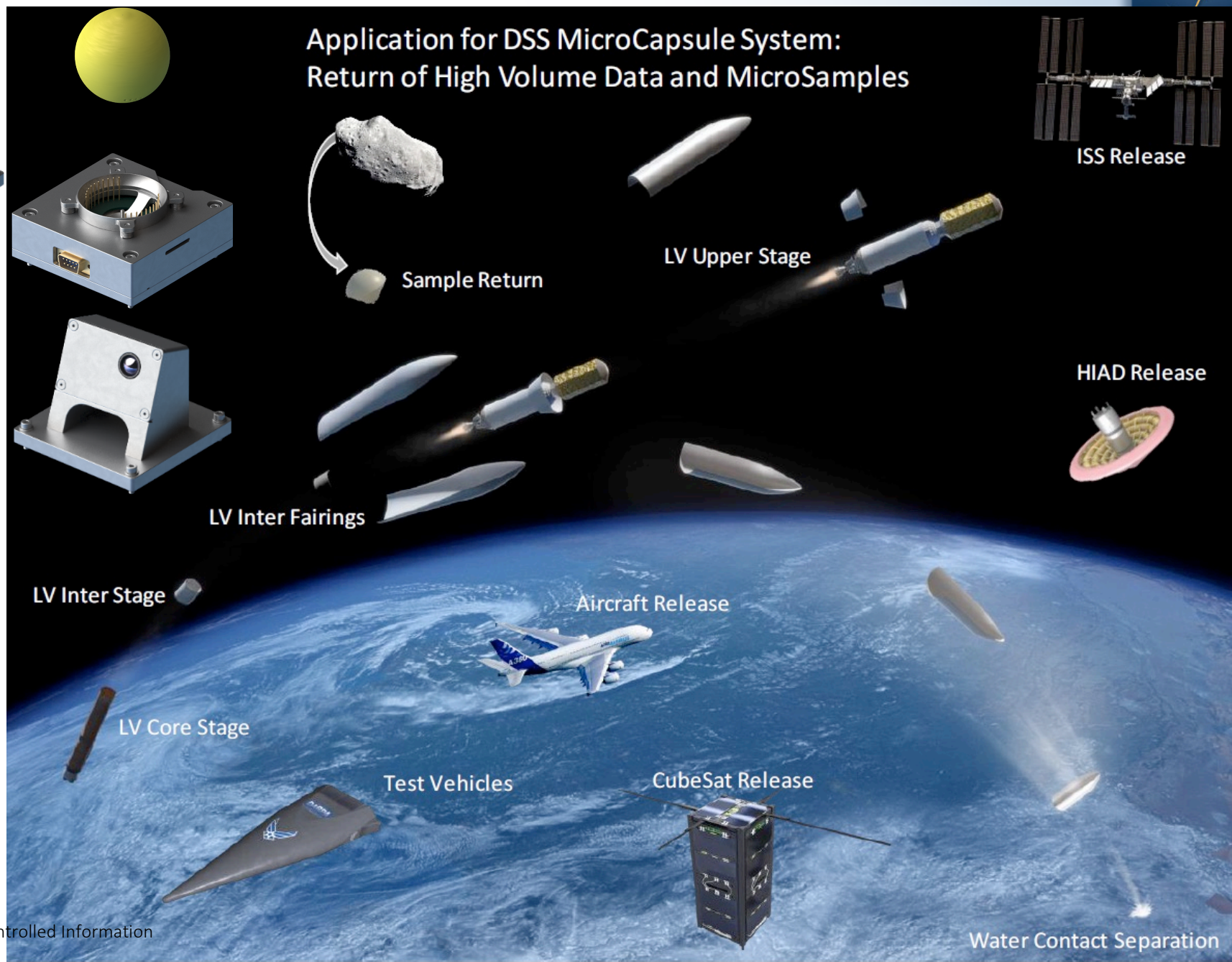


DARS Retention and Release System
AKA Power and Data Controller (PDC)

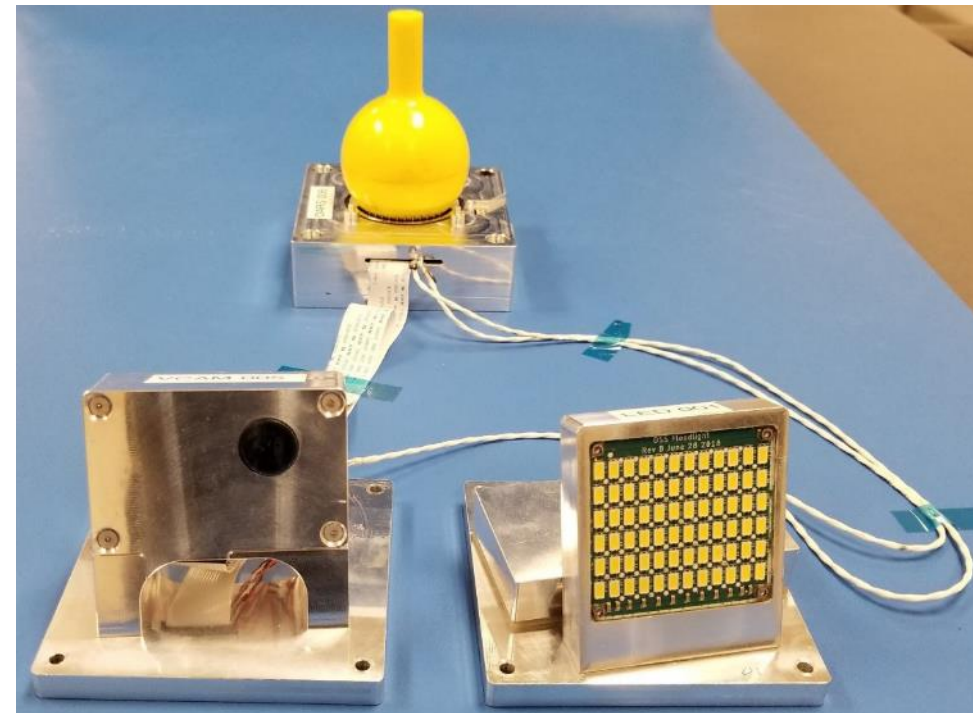
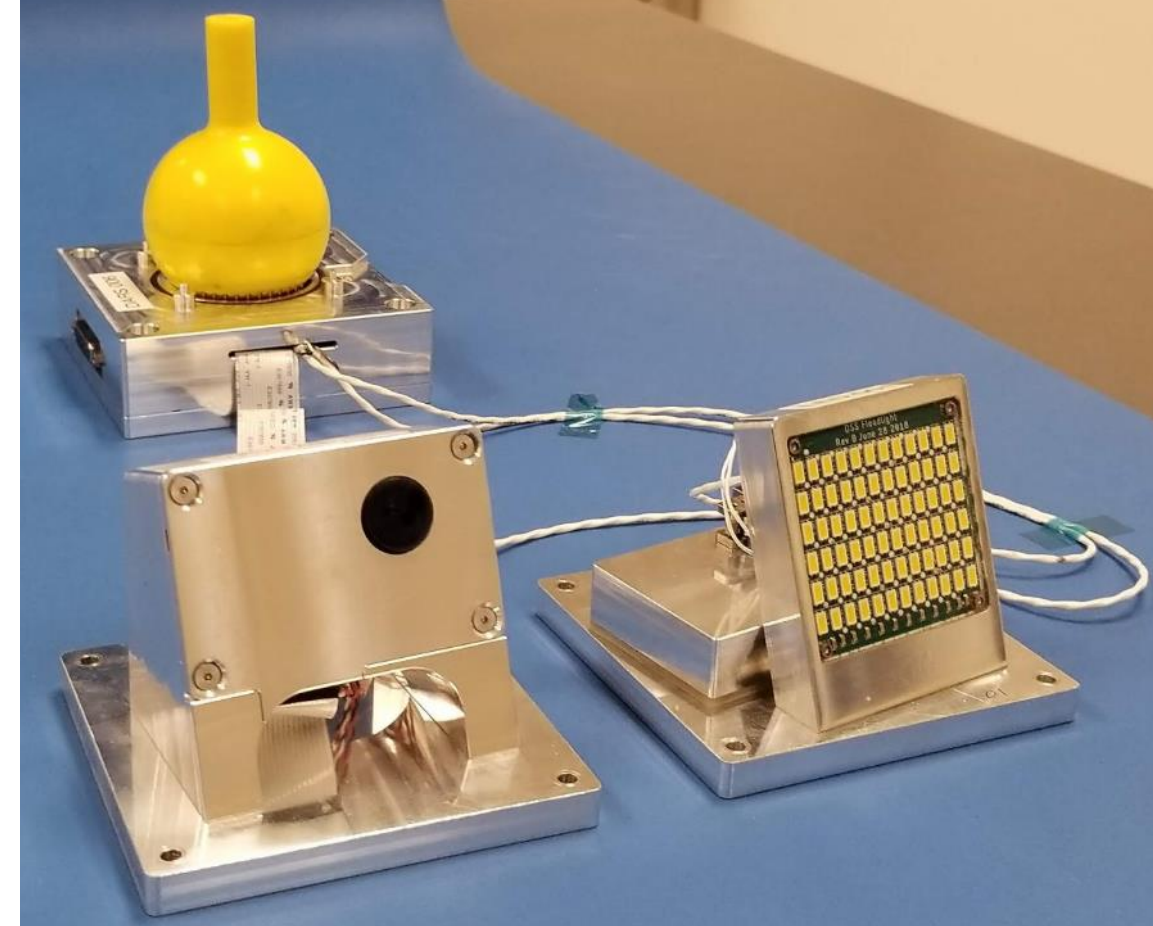
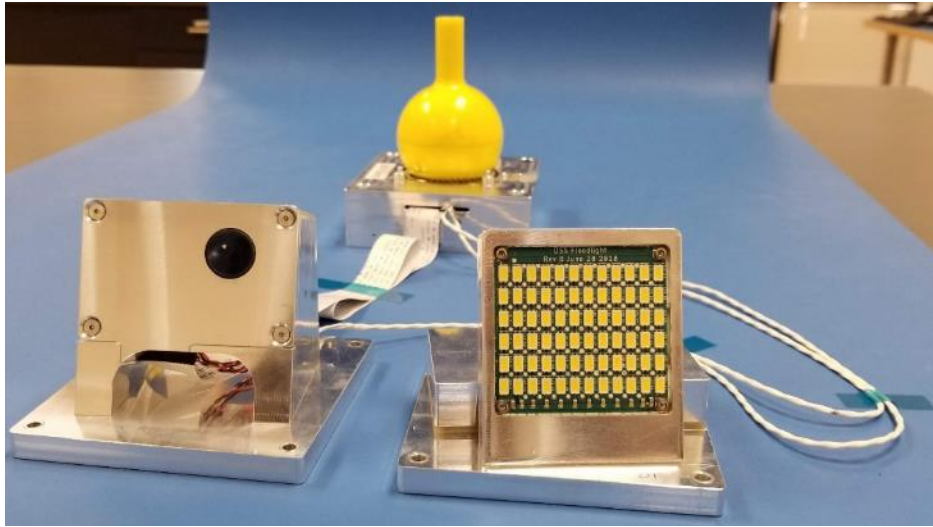


DARS LoRa
Mobile Ground Station

Contains Export Controlled Information



DARS, Camera and Floodlight Qualification Hardware





DSS In-House Test Capabilities Include: Vibe, Shock, Thermal Vacuum, Calibration and RF Performance

Shock & Vibration Testing
(Up to 45 GRMS for Cameras)

Thermal Vacuum and
Thermal Cycle Testing
Chamber 2 and 3





DSS Flight Hardware Production Facilities



DSS Customers

