

National Aeronautics and  
Space Administration



# EXPLORE MOON<sub>to</sub>MARS

## Moon to Mars Update

Dr. David Burns  
Acting Deputy Associate Administrator for Exploration  
Science Mission Directorate, NASA

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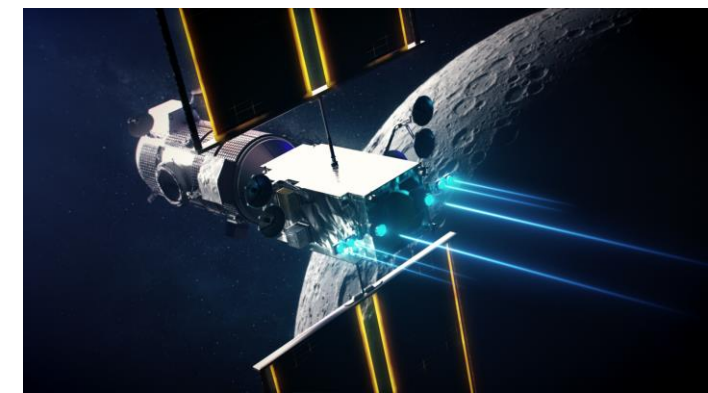
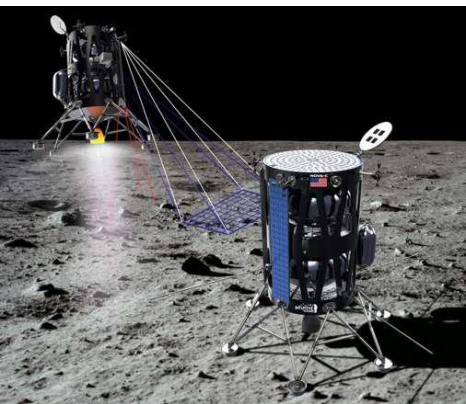
# Exploration Science Strategy and Integration Office (ESSIO) formulates & executes an *integrated strategy* for exploration science



## Implementation Strategy

- Develop lunar surface science instruments
- Use commercial companies to deliver payloads to the Moon
- Develop mobility systems to expand and enhance science investigations on the surface
- Leverage international partnerships for additional opportunities (e.g., instruments, rovers)
- Obtain new scientific data from lunar orbit using smallsats
- Use new human exploration systems, such as Gateway and human landing systems, to enable science
- Lead the science mission planning for humans on the lunar surface

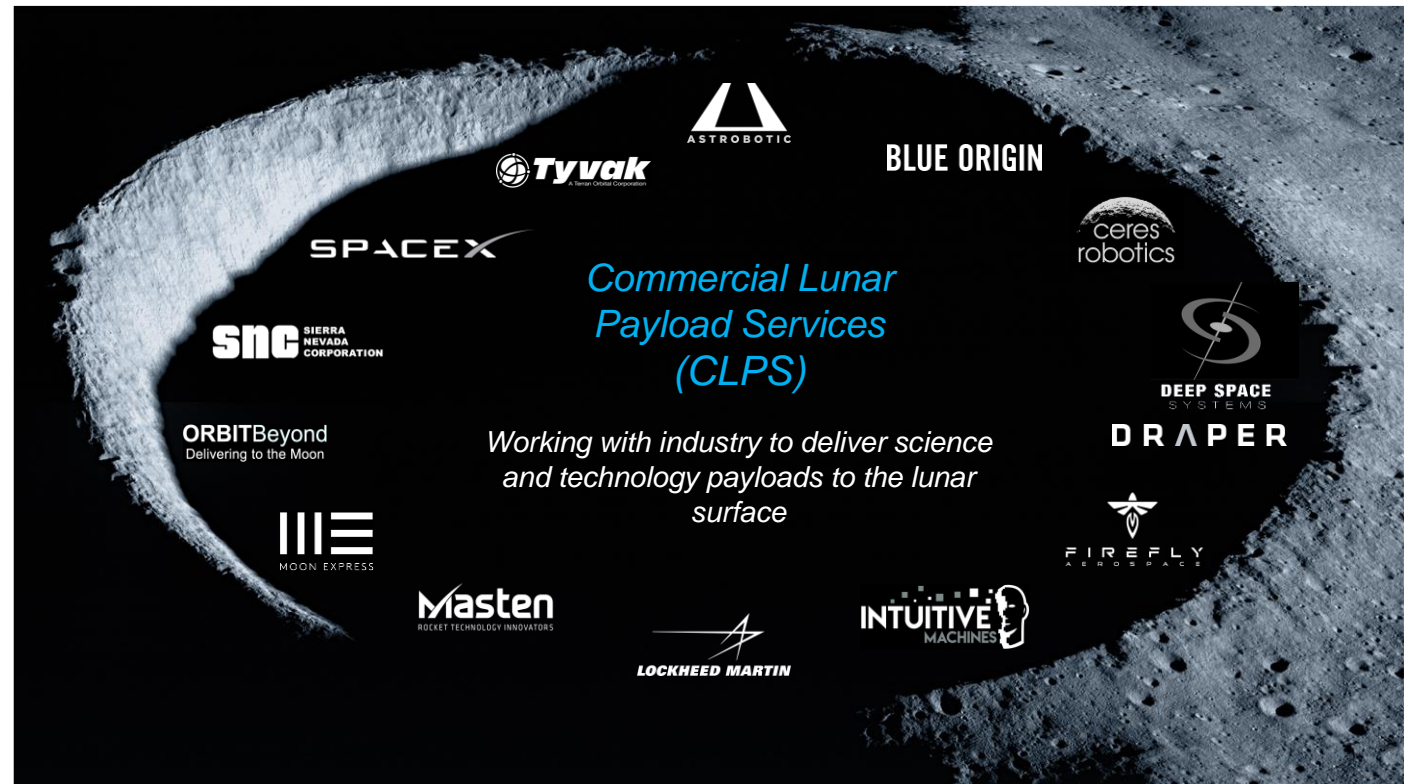
Lunar  
Discovery &  
Exploration  
Program  
(LDEP)





# Commercial Lunar Payload Services (CLPS)

- **Goal: Utilize commercial end-to-end delivery services to enable access to the lunar surface**
- Deliveries initiated using a Task Order
  - Any of the 14 companies on the catalog can respond to a task order
  - Expected Task Order cadence of 2 per year
- Task order lists what NASA wants delivered, and any constraints
  - E.g., landing site, specific needs of instruments
- First 4 lunar surface delivery task orders awarded with deliveries commencing in 2021
  - 2021: Non-polar delivery (Astrobotic and Intuitive Machines) – TO 2A & 2B
  - 2022: Polar delivery (Masten) – TO 19C
  - 2022: PRIME-1 (Intuitive Machines)
  - 2023: Volatiles Investigating Polar Exploration Rover (VIPER) to Moon's south polar region (Astrobotic) – TO 20A





# CLPS Deliveries & Future Payloads

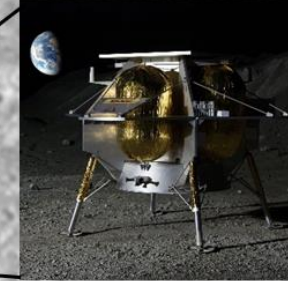
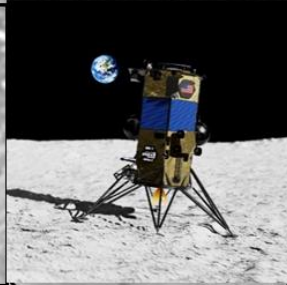
Payloads for early CLPS deliveries from NPLP (NASA internal) and LSITP (external) calls, were focused on speed. Now we are working towards a science-driven model via **PRISM (Payloads and Research Investigations for the Surface of the Moon)**.

- PRISM calls occur at a regular cadence
  - PRISM instruments feed manifests for deliveries from late 2023 onwards
  - First PRISM call requests science investigations utilizing multi-instrument suites to maximize the science for named locations
  - High-value 'location agnostic' instruments may be called for in PRISM-2
- As discussed in community documents, the locations are high science-value targets where significant progress can be made utilizing CLPS platforms; the locations for this call are:
  1. Reiner Gamma magnetic anomaly (lunar swirl)
  2. Schödingen farside basin impact melt
- Destinations for these two deliveries were announced in July, allowing PIs ample time to propose science optimized for those locations
  - Step 1 proposals received in December, and step 2 proposals due Feb 3
- Although PRISM call focuses on science payloads, other Mission Directorate payloads can be incorporated into Task Orders through the 'CLPS payload ingest process'



# CLPS Deliveries 2021-2024

Delivery Site:  
***Oceanus Procellarum***  
Provider:  
***Intuitive Machines***  
***Task Order (TO) 2 | 2021***



Delivery Site:  
***Lacus Mortis***  
Provider:  
***Astrobotic***  
***TO2 | 2021***

Delivery Site:  
***Lunar Pole***  
Provider:  
***Astrobotic***  
***VIPER | 2023***

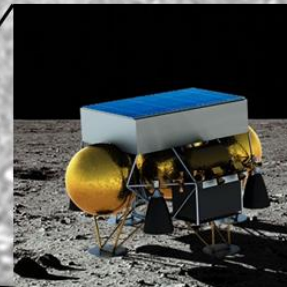
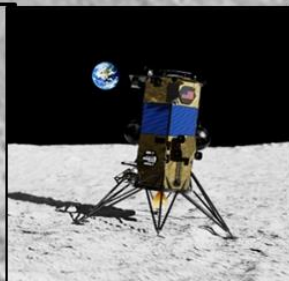


Delivery Site:  
***Reiner Gamma***  
Provider: TBD  
***PRISM-1a | 2023***

Delivery Site:  
***Mare Crisium***  
Provider: TBD  
***TO19D | 2023***

Delivery Site:  
***Schrödinger Basin***  
Provider: TBD  
***PRISM-1b | 2024***

Delivery Site:  
***South Pole***  
Provider:  
***Intuitive Machines***  
***TO PRIME-1 | 2022***



Delivery Site:  
***South Pole***  
Provider:  
***Masten***  
***TO19C | 2022***



# TO2 – ASTROBOTIC TECHNOLOGY

## July 2021 Launch



# TO2 – INTUITIVE MACHINES

## October 2021 Launch



# 2021 CLPS Delivery Manifests

Payloads largely selected from  
NASA Provided Lunar Payloads (NPLP)

## Astrobotic

Surface Exosphere  
Alterations by  
Landers (SEAL)

Photovoltaic  
Investigation on  
Lunar Surface (PILS)

Near-Infrared  
Volatile  
Spectrometer  
System (NIRVSS)

Mass Spectrometer  
Observing Lunar  
Operations (Msolo)

PROSPECT Ion-Trap  
Mass Spectrometer  
for Lunar Surface  
Volatiles (PITMS)

Linear Energy  
Transfer  
Spectrometer  
(LETS)





Neutron  
Spectrometer  
System (NSS)

Neutron  
Measurements  
at the Lunar  
Surface (NMLS)

Fluxgate  
Magnetometer  
(MAG)

Navigation  
Doppler Lidar  
for Precise  
Velocity and  
Range Sensing  
(NDL)

### Key

|             |   |
|-------------|---|
| Science     |  |
| Technology  |  |
| Exploration |  |
| HEOMD/STMD  |  |

## Intuitive Machines

Lunar Node 1  
Navigation  
Demonstrator (LN-1)

Stereo Cameras for  
Lunar Plume-Surface  
Studies (SCALPSS)

Low-frequency Radio  
Observations from the  
Near Side Lunar  
Surface (ROLSSES)

Navigation Doppler  
Lidar for Precise  
Velocity and Range  
Sensing (NDL)

Radio Frequency Mass  
Gauge (RFMG)





# The Moon Enables Scientific Exploration

## A CORNERSTONE

For Solar System science and exoplanet studies

## A TRAINING GROUND

To learn how to conduct scientific exploration from a planetary surface, working synergistically with crew and robotic explorers

## A NATURAL LABORATORY

To study planetary processes and evolution

## AN OPPORTUNITY

To use infrastructure and resources associated with human exploration to leverage support for autonomous scientific investigations