National Aeronautics and Space Administration

NASA

EXPLORE SCIENCE

Exploration Science Strategy and Integration Office: Commercial Lunar Payload Services

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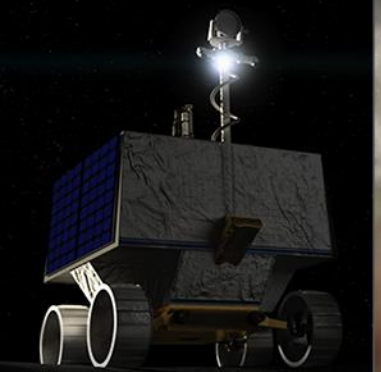
Near Term Exploration Plans

COMMERCIAL LUNAR PAYLOAD SERVICES
Small Payload Deliveries to the Moon



ARTEMIS I
Space Launch System (SLS)/Orion Uncrewed Test Flight

ARTEMIS II
Crewed Mission to Lunar Orbit Aboard SLS/Orion

GATEWAY:
Power Propulsion Element/Habitation & Logistics Outpost
First Gateway Elements Integrated for Launch; Science Operations Begin

INITIAL HUMAN LANDING SYSTEM
Delivered to Lunar Orbit

ARTEMIS III
Crewed Mission to the Lunar Surface

SURFACE MOBILITY
Lunar Terrain Vehicle to the Lunar Surface

Conducting science missions on Mars in preparation for human exploration

Commercial Lunar Payload Services (CLPS)

- CLPS is an innovative, service-based, competitive acquisition approach that enables rapid, affordable, and frequent access to the Lunar surface via a growing market of American commercial providers
- The CLPS contract is an indefinite duration indefinite quantity (IDIQ) contract awarded to 14 domestic teams who are all eligible to bid for Task Orders
- Service task orders are firm fixed price (FFP) for the full scope of delivery: from payload hand-over to delivery (and often operation) on the lunar surface
    - All payload requirements must be captured in the originating Request for Task Order Proposal (RFTOP)
- NASA wants to be one of many customers for CLPS services
- CLPS deliveries are CLPS Provider missions (not NASA missions)
- CLPS systems/facilities are owned or contracted by the CLPS Provider (not NASA)
- CLPS launches are commercial launches provided via the CLSP provider (not LSP) and approved/licensed by the FAA and other agencies (not NASA)

CLPS Payload Services

- CLPS payloads are customer-owned, delivered items.
  - Transfer of custody, but not ownership
- CLPS Providers responsible for the safe integration, delivery, deployment and/or operation of payloads
  - Accommodation of payload interface, operation, and environment requirements
- CLPS Providers secure all necessary hardware, systems, facilities and services to perform the delivery
  - LSP is not engaged in their launch vehicle acquisition
  - DSN (if required by CLPS contractor) is acquired by CLPS Contractor via RSAA
- Service tasks may include:
  - Physical operation of a payload (i.e., command/data/power)
  - Payload release/deployment with or without wireless/tethered services
  - Passive delivery (e.g., laser reflectors, EPO items)
  - Augmented insight

CLPS Evolution and On-Ramping

- The menu of CLPS services is expected to expand as the market forces and company capabilities evolve
  - Estimating periodic on-ramp opportunities going forward depending upon need and service availability
  - The existing CLPS IDIQ maintains the flexibility to award task orders for upcoming capabilities, as well as data buys
  - Possible evolution areas include:
    - Survive / Operate through the lunar night
    - Increased delivery mass/volume
    - On-orbit delivery
    - Mobility services
    - Return delivery
    - Permanently Shadowed Regions (PSR)/Cold Operation

CLPS: Rapid Affordable Frequent Access to the Lunar Surface

CLPS Current Portfolio

- Competition open to U.S. commercial providers of space transportation services, consistent with National Space Transportation Policy and Commercial Space Act
- Structured for NASA as one of many customers of commercial service
- On ramps to the CLPS contracts will be used to provide additional capabilities as made available
- 14 domestic companies eligible to compete for Lunar surface delivery task orders
- 6 awarded lunar surface deliveries actively in work with initial deliveries as soon as November 2021.

First Round CLPS companies (Nov 2018):

- *Astrobotic*
- *Deep Space Systems*
- *Draper*
- *Firefly Aerospace*
- *Intuitive Machines*
- *Lockheed Martin Space*
- *Masten Space Systems*
- *Moon Express*
- *Orbit Beyond*

First On-Ramp (Nov 2019):

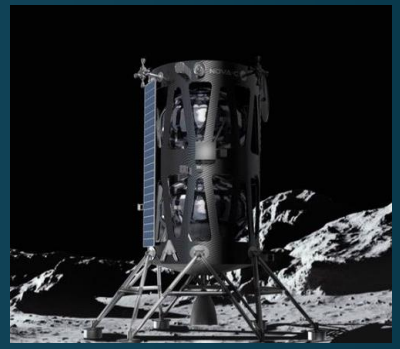
- *Blue Origin*
- *Ceres Robotics*
- *Sierra Nevada Corporation*
- *SpaceX*
- *Tyvak Nano-Satellite Systems, Inc.*

TO2 2021
Astrobotic
Peregrine

TO2/20C 2021
Intuitive Machines
NOVA-C

TO19C 2022
Masten
XL-1

TO PRIME-1 2022
Intuitive Machines
NOVA-C



TO20A 2023
Astrobotic
Griffin

TO19D 2023
Firefly Aerospace
Blue Ghost

CLPS Manifest Selection

- CLPS delivery manifests are selected through the CLPS Manifest Selection Board (CMSB)
  - The CMSB includes representatives from SMD, HEOMD, STMD, OIIR, and the CLPS Project Office
- Selected payloads are chosen from among solicitations to the community, directed work, and international contributions; payloads are based on priorities and available budget from each respective Mission Directorate
  - International Partner payloads are generally represented by a “sponsoring” or “representative” mission directorate.
- SMD will primarily use the Payloads and Research Investigations on the Surface of the Moon (PRISM) solicitation, planned approximately annually.
  - PRISM solicitations are open to HEOMD/STMD and will state the location for each delivery, allowing PIs to propose science optimized for those locations
    - ❖ High-value ‘location agnostic’ instruments and network science will be in future calls
    - ❖ International contributions to PRISM investigations may be included at up to 30% the total cost of the investigation
  - PRISM will also call out previously identified payloads for a particular delivery in order to solicit for complementary investigations and reduce redundancy

CLPS Manifest Selection Board Process

Step 1

MD, other Agency, or Int'l Partner Identifies Need for CLPS Delivery

- Representative approaches ESSIO about potential delivery*
- Payload gets added to candidate payload list from which future CLPS delivery manifests will be generated

Step 2

Pre-manifesting by CMSB

- CMSB meets to review candidates and allocate payloads across next several CLPS deliveries
- CMSB identifies capacity limits that support competition and non-NASA customer encouragement
- Foundational payloads are identified that could drive delivery parameters.
- CMSB identifies preliminary manifest including set payloads and constrained allocations
- Draft MOAs between ESSIO and Payload MD's/external entities covering cost and data sharing

Step 3

Solicitations & Payload Refinement

- Selection processes employed to fill Step 2 allocations within defined constraints.
- PRISM is the SMD-preferred competitive process to select payloads, and may be used by other MDs
- PRISM solicitation mentions predefined delivery characteristics and other pre-manifested payloads from other MDs, agencies, or international contributions from Step-2 to minimize redundancies
- All payloads mature requirements and interface definitions

Step 4

Manifest Finalization by CMSB

- The CMSB builds final manifests for upcoming CLPS deliveries
- CMSB ensures compatibility with Agency priorities, objectives, and commitments; and compliance to all requirements/limits.
- CMSB ensures payload interfaces/requirements are mature enough to write RFTOP.
- If the Step 2 allocations have not been filled, the CMSB *may* elect to add new payloads to the final manifest if Step 5 schedule can accommodate
- Confirm or update MOAs

Step 5

CLPS RFTOP & Award

- ESSIO works with the CLPS Project office to develop the request for task order proposal (RFTOP)
- Release draft RFTOP to CLPS vendors
- Host workshop with vendors and manifest PIs
- Release final RFTOP
- Review proposals with input from MD stakeholders
- Award task order
- Finalize MOAs

Step 6

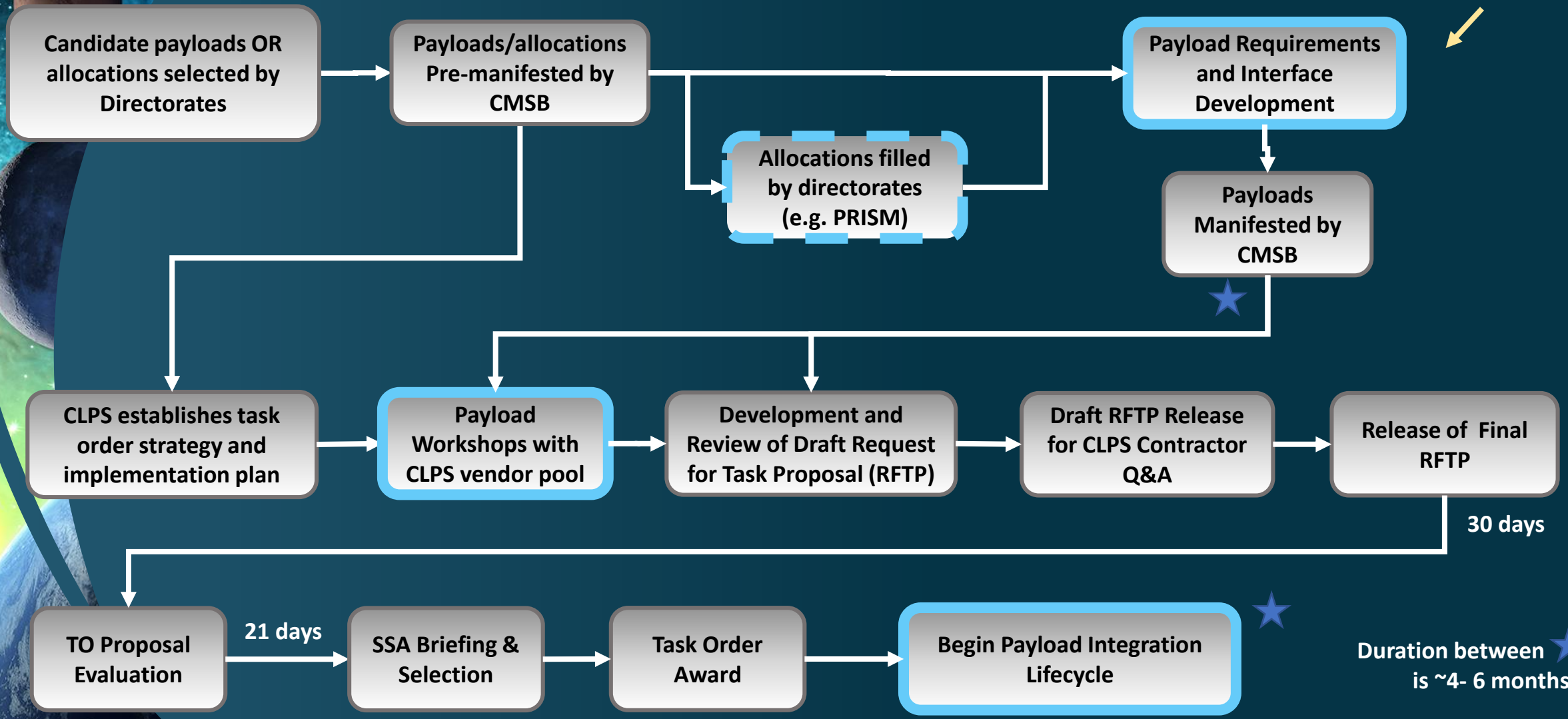
Post-Award Directed Work

- On a priority exception basis only, otherwise to be avoided.
- Value-added provider-specific scope.
  - Data buys.
  - Accommodation of pre-existing non-CLPS SAA scope (e.g. in-line tech demos)
- If this additional scope is desired and justifiable
  - Commence with "JOFOC" TO
  - Adjust Cost Share Agreements and update MOAs.

Typical Lunar Payload Manifesting Process

★ NASA Mission Directorate or Partner Strategic Objectives

Note: Fixed price CLPS vendors are driven by upfront requirements definition in RFTP for payload accommodations.



Payload Support

- Payload Integration Manager (PIM)
  - Assists payloads in requirement specification for RFTOP
  - Provides primary interface between payloads and provider
  - Brokers agreements for landing site, document, data, and system deliverables
  - Adjudicates mission resources for payloads as necessary
  - Ensures provider meets RFTOP requirements
  - Works with NASA payload manager for payload deliveries to CLPS Provider
  - Facilitates payload ops changes during operations
- Project Scientist
  - Formulates NASA's science objectives and success criteria
  - Coordinates with all NASA payloads within a delivery manifest to maximize science value for NASA
  - Develops landing site proposal with payloads
  - Manages payload operational plan development
  - Oversees Science Operations during mission
  - Adjudicates science priorities under enhanced or constrained ops scenarios
  - Oversees science operations during mission; coordinates contingency ops planning

Payload Requirements

- The Request for Task Order Proposal includes the payload requirements which must be met by the CLPS provider.
- CLPS Providers are required to “accommodate” the needs of the payloads.
  - Paradigm shift to specify to the spacecraft what is needed rather than to “deal with” what is available.
  - Utilities: power, data, commanding, etc.
  - Mounting: fields of view, alignments, co-locations, etc.
  - Environments: thermal, vibe, emi/emc, etc.
  - Operations: conops, mission phases, ops durations, uplink/downlink rates and durations
- **CLPS Task Orders are generally awarded competitively**
  - Payloads should therefore not be designed toward a specific CLPS provider.
- **Firm Fixed Price (FFP) Task Orders necessitate stable definition of interfaces and requirements PRIOR to release of the Request for Task Order Proposal (RFTOP).**
  - If it is not defined in the RFTOP then it is defined de facto by the CLPS provider, or else is a “new” requirement at a cost.

Affordable Accommodation

- CLPS deliveries themselves are most affordable when payloads are “easily accommodated”, but affordability and value principles apply to both the payloads and CLPS providers.
  - Existing payloads, build-to-print, or heritage designs should generally maintain their established requirements & configurations.
  - Where payload design decisions are open, payload accommodation requirements should be driven by payload objectives while avoiding exotic, outdated, or demanding accommodations.
    - Examples of challenging requirements: highly complex geometries, tight pointing requirements, overlapping and complex fields of view with multiple boxes, many mode changes, etc.
  - Restraint/elimination of optional “normally available” capabilities can aid affordability.

Payload Workshops

- These are held prior to release of a Draft RFTOP.
- An opportunity for payloads to brief their instruments to the CLPS providers pool and answer questions
- The CLPS team also provides an overview of the intended solicitation, including a discussion of the evaluation criteria
- Payloads present an overview of their system:
  - Hardware or Instrument Overview
  - Science or Technology Demonstration Objectives
  - Ops concepts and timelines
  - Current best understanding of the payload/lander interfaces and accommodation requirements
- CLPS providers will be able to ask questions of the payloads to better understand the requirements and functions of the instruments
- Results and clarifications are factored into the Draft RFTOP solicitation
- After Draft RFTOP released, providers may pose formal questions which are shared with all interested proposers and may be incorporated into final solicitation.

Typical Payload Integration Lifecycle

Lunar Payload Delivery Vendor Selection

Payload/ Lander F2F Meeting

Payload & Lander Overviews, Lander Services, Points-of-Contact, Deliverables & Integration Milestone Schedule

Payload Integration Readiness Review

Lander/LV Integration Readiness Review

Flight Readiness Review

Lunar Landing

Payload I/F & Ops Rqmts Definition

Data Deliverables Exchanges: 3D CAD Models, Mission Thermal Environment, Mission Ops Timelines; Payload Placement

Lander & Payload Compatibility Analyses

Integration Working Group Meetings

Baseline PIPs, ICDs, Payload Integ Schedules

Payload Hardware Production, Assembly, Integration & Test

Payload Flight Hardware Turnover & Lander Integration

Payload Functional Testing, Lander/Payload Integrated Testing

Lander/Launch Vehicle Integration

Payload Testing, Lander/Launch Veh Integ Testing

Launch Ops

Lunar Surface Ops

Lunar Landing

Lunar Transit

Launch

Payload Design, Development, Assembly, Test

Lander Design, Development, Assembly, Test

Payload Deliverables for Integration

CLPS Provider is responsible for integration, but Payload is responsible to SUPPORT Integration

“Integration” is a full lifecycle process (not just the physical integration) which may include:

- Payload models to feed Provider analyses (Mass, thermal, structural, etc)
- Do No Harm data/analysis products (EMI/EMC, Materials, Hazards, etc)
- Ground support equipment (electrical and mechanical), handling fixtures, etc
- EDU hardware to test electrical and mechanical interfaces
- On-site / on-line support
- Integration working groups / meetings
- ConOps and Operations Plans
- MOC/Data integration
- Final Data Package/Inputs to Provider’s compliance documentation (Drawing packages, ICD V&V test reports, Bill of Materials (off-gassing, non-metallics, etc), Range Safety, Structural Modes, etc)
- Handling, integration, Test & Check-out instructions
- Storage until needed

In Summary

- CLPS is an innovative, service-based, competitive acquisition approach that enables rapid, affordable, and frequent access to the Lunar surface via a growing market of American commercial providers.
  - PRISM is not part of CLPS, but is a separate SMD procurement mechanism for PI-led science instrument suites, which are intended for lunar delivery aboard a subsequent CLPS delivery flight.
- All NASA-sponsored payloads (including PRISM awardees) are manifested by a CLPS Manifest Selection Board with multi-directorate representation.
- CLPS Delivery Task Orders for NASA-sponsored payloads, so payloads seeking NASA sponsorship are strongly dissuaded from tailoring their payload to any specific CLPS provider.
- CLPS Task Orders are firm fixed price, so all payload-sourced requirements must be known and documented prior to a CLPS RFTP release.
- All NASA-sponsored payloads will be assisted by a PIM and Project Scientist to guide you through the integration process and maximize your science.


NASA
EXPLORE MOON to MARS
MOON LIGHTS THE WAY