National Aeronautics and Space Administration

Lunar Orbital Platform-Gateway
Management Directive
DSG – MD – 10000
Date: May 22, 2018

To: Distribution

From: Jason Crusan
Concept Formulation Lead, Lunar Orbital Platform-Gateway

Subject: Lunar Orbital Platform-Gateway Configuration

I. BACKGROUND:

Together with the Space Launch System (SLS) and Orion, the Gateway is central to advancing and sustaining human space exploration, and is the unifying single stepping off point in the architecture for human cislunar operations, lunar surface access, and missions to Mars.

II. STRATEGY:

NASA will serve as the integrator of the the Gateway. Through partnerships both domestic and international, the Gateway team will bring innovation and new approaches to achieve human spaceflight goals and objectives. The Gateway will be developed in a manner that will allow future capabilities and collaborations with U.S. Government, private sector companies, and international partners.

III. GATEWAY OBJECTIVES:

In preparation for human missions to the lunar surface and other deep space destinations, it is essential that the Gateway meet a core set of objectives through the 2020s while providing critical infrastructure for the next phases of human exploration. The following objectives shall be enabled by the Gateway:

- Sustained human presence around and on the Moon
- Provide a staging point that can be used for multiple missions both to the Moon and beyond, enabling reusable in-space systems
- Demonstration of key capabilities required for deep space missions
- A regular cadence of human crewed missions to cislunar space including capabilities that enable lunar surface mission
- Capabilities to meet scientific requirements for lunar discovery and exploration, as well as other science objectives, as appropriate
- Demonstrate and validate technologies that are enabling for lunar missions and feed forward to Mars as well as other deep space destinations
- Demonstrate the systems and operational capabilities required for crewed missions beyond the Earth-moon system

IV. GATEWAY FUNCTIONS:

To achieve these objectives, the current concept distributes necessary functions across Gateway, including: power and propulsion (and communication), habitation/utilization, logistics resupply, airlock, and robotics. The functional goal is to develop an effective habitation/utilization capability comprised of pressurized volume(s) with integrated habitation systems and components, docking ports, environmental control and life support systems (ECLSS), avionics and control systems, radiation mitigation and monitoring, fire safety systems, autonomous capabilities, utilization, and crew health capabilities, including exercise equipment.

V. GATEWAY ARCHITECTURE:

Studies of the architecture trade space and potential Gateway configurations have revealed a baseline concept that can satisfy the identified functions as well as achieve U.S. and international partner objectives. Through analysis, several Gateway configurations were identified that could meet these functions and objectives to varying degrees. The analysis informed the determination that the following capabilities will be the baseline for the next Integrated Analysis Cycle of the Gateway architecture configuration:

- Power and Propulsion Element (PPE): Provides transportation for the Gateway between cislunar orbits with the option to perform orbital maintenance. It will provide attitude control for the Gateway in multiple configurations, communication to and from Earth, space-to-space communication, space-to-lunar communication, and in support of astronaut EVA. PPE will also deliver systems necessary for deep space navigation, docking, and refueling.

- European Space Agency (ESA) System Providing Refueling Infrastructure and Telecommunications (ESPRIT) Element: A structure that provides the following functions:
  - science airlock to facilitate experiments in deep space
  - augmented telecommunications capability for the Gateway
  - fuel storage and refueling capacity for xenon and hydrazine for PPE
  - external payload capability

- Utilization Element: A small pressurized volume that will provide for early utilization of the Gateway. Key functions include axial and radial docking ports; internal and external payload accommodations; external robotic interfaces; power and thermal system; oxygen supply and air circulation; and logistics storage for crew consumables.

- Habitation Element: Two habitable modules that will provide short-duration life support functions for the crew in cislunar space. Habitation functionality will be distributed across the Utilization Element and the two habitation modules to meet the full Gateway habitation functionality needs.

- Logistics Modules: Delivers cargo to the Gateway to enable extended crew mission durations, science utilization, exploration technology demonstrations, potential commercial utilization, system outfitting and other necessary supplies. Future logistics modules may or may not be permanent fixtures of the Gateway and will depend on individual element configurations. Also, the cadence of logistics deliveries will be driven by mission needs.

- Robotic Arm: Provides the functionality of deploying and retrieving external utilization payloads, external inspection of the Gateway system, berthing of robotic spacecraft, contingency maintenance and EVA crew translation.

- Airlock Element: Provides the Gateway with the capability to enable astronaut EVAs as well as the potential to accommodate docking additional elements, additional refueling, observation ports or additional science utilization.

These elements can be grouped as various launch packages depending on the launch vehicle manifesting plans. The first element of the Gateway, the PPE, will be launched first aboard a commercially provided vehicle.

VI. CANDIDATE CONTRIBUTIONS:

While NASA will remain the overall lead as Gateway architect, systems integrator, and operator, the Gateway team has been studying various implementation approaches to identify the U.S. commercial and international contributions to the Gateway architecture. The U.S. commercial efforts include the design concepts initiated under NASA's Next Space Technologies for Exploration Partnerships (NextSTEP) habitation development activity and the international concepts have been identified through architecture studies with the International Space Station (ISS) partners.

The contributions identified below, capture the top-level strategy to providing the high-level Gateway elements. System and sub-system contributions are still under assessment. The specific partners, element providers, and/or leads (i.e., agencies, companies, organizations) for the elements will be further derived through the acquisition process. Based on these combined efforts, the following candidate contributions have been identified:

Potential U.S. Domestic Contributions:

- Power and Propulsion Element: The development of PPE will leverage U.S. commercial satellite expertise.
- Utilization Element: The U.S. will provide this small pressurized volume with multiple concepts for implementation under analysis.
- Habitation Element: The U.S. will provide one of the two Gateway habitation modules.
- Logistics Modules: Logistics modules will be delivered to the Gateway by both U.S. and international partners. Cadence of logistics deliveries will be driven by mission needs.

Potential International Partner Contributions:

- ESPRIT Element with science airlock including additional propellant storage and advanced lunar telecommunications capabilities
- Habitation Element: international partners will lead the development of one of two Gateway habitation modules.
- Logistics Modules: Delivered to the Gateway by both U.S. and international partners. Cadence of logistics deliveries will be driven by mission needs.
- Robotic Arm

The functionality and implementation approach for the Airlock element is still being assessed so potential providors have not been allocated.

VII. FORWARD DIRECTION:

The Gateway Formulation Team is proceeding with Integrated Analysis Cycle 2 (IAC-2) and should use the identified objectives, functions, configurations, and elements as the baseline going forward toward the Formulation Sync Review (FSR) in Fall 2018. Through IAC-2, the team should identify Level 2 requirements for the identified elements including the functional allocations across the pressurized volumes. Any changes to this baseline architecture shall be identified as a Change Request and will follow the Gateway Control Board processes for decision.

In conjunction with IAC-2 and the updated baseline architecture, internal and external communications materials will be developed and provided to the teams for use in product development. Policies for use and distribution of imagery and other multi-media products will be shared broadly with the Formulation Team.